THE

ELECTRICAL REVIEW.

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THE MEASUREMENT OF ELECTRICAL ENERGY.

MUCH has been written on "the evolution of the incandescent lamp," but comparatively little on the evolution of the electricity meter. Perhaps it is because the meter is but little understood by the average station manager who prides himself upon being an engineer rather than an electrician; or, it may be, that it is held to be an inevitable nuisance in the business of general supply, but no less a nuisance for all that. Whatever may be the reason, we must confess that the metering arrangements to be found on the circuits of many central stations are anything but creditable to those responsible for their existence, and despite Prof. Kennedy's repeated warnings on the subject, and the good example set the profession by Mr. Crompton, we are still a long way from a proper appreciation of the due importance of this rather neglected subject.

The alternative to a meter system of charging for a supply, that of contracting, has been tried over and over again in this country and found wanting, and although it still flourishes with some vigour in the United States, recent utterances on the part of speakers at American gatherings of the electrical fraternity lead one to the conclusion that its weaknesses have been fully exposed, and will not be overlooked by such keen business men as have the control of the large supply systems in America. After all, it is out of the question for us to forget that two out of the four or five types of electricity meters which have so far been found of practical use in this country have come to us from across the Atlantic. One of these has had prominence given to it by being officially sanctioned for use by the Board of Trade, who seem reluctant to do anything further in the matter. Those who are acquainted with the form in which the approval was given certainly feel secure in accepting the statements made by the responsible officials of the department, although there is at the same time a sense of uneasiness when it is found that barometric pressure is such an important factor in the accuracy of an instrument upon which so much depends.

In an article in this issue we describe one of the most important meters that have been designed and made in this country. It exhibits many points of great ingenuity, and from the favourable reception accorded to it one may expect to see a large number in practical use within a short time. It is not, however, more carefully designed, nor has more ingenuity been displayed in its construction than has been shown on many of the earlier forms which have left a name in textbooks, but not much of a practical record behind them. The principles upon which the errors inherent in motor meters have been combated may be novel, but it is not by any means the first time that inventors have sought

for a means to render these troubles innocuous. The difficulties are twofold; firstly, the friction at starting is considerable, and causes the meter to read low unless corrected, and secondly, the laws of fluid friction do not permit of a proportionality throughout the scale, unless the variation in the coefficient is compensated. In the old Ferranti-Wright-Borel meter both these points were considered. As the friction of the spindle at starting was relatively large, the magnets were wound with a shunt coil that was just sufficient not to cause the disc spindle to revolve, and as at high speeds the air resistance depends on a rather higher power than the square of the velocity, the brake fans were slit so as to yield somewhat, and expose a smaller effective surface. In the meter we dealt with last week, a very beautiful action was introduced in lieu of the shunt coil, to get over the first one of the great sources of error in motor meters, the variation of friction at light loads, due to the wearing away of the bearing at heavy loads, this being accomplished by the method of running on the upper bearing at light loads only. A meter should have a straight line law; it should not be merely cooked till it gives something like correct readings. As Mr. Swinburne has pointed out, a meter thus differs essentially from a voltmeter or ammeter, as the scale cannot be made to suit the instrument. Unfortunately, even where there is a definite law as basis, there are sources of error which must either be made small, or compensated. The error due to fluid friction and reaction of fields can be reduced or compensated. In the meters described, fluid friction is compensated, and the tests show how closely this is carried.

Next to the question of accuracy come a number of others relating to convenience in use of meters. One of the first is their designation. As they are objects of interest, and frequently of solicitous care on the part of the public, it will never do to call them coulomb-meters or joule-meters, for the consumer does not buy electricity or electrical energy under such titles. The Elihu Thomson meter is called a "watt-meter," and, in doing this, those who give it the name are evidently in error, for it is not a wattmeter at all. Sometimes it is called an "integrating wattmeter," which is nearer the mark. When the proposal was made to Lord Kelvin to christen the unit of electrical energy the "Kelvin," he demurred, and suggested, as a more appropriate term, "supply unit." Mr. Preece had already pressed for it to be spoken of as the "Bot." The latter, as B.O.T., is a convenient form in writing, but hardly for conversation, and if more generally adopted, would have "B.T.U." for their legitimate meaning as "British Thermal Unit." Supposing that supply unit be accepted, then the meter for measuring a supply would become a "supply meter," and in like manner the differential air thermometer developed by Mr. Arthur Wright into a maximum reading ammeter, would be simply known as a "demand meter," terms the general public could quickly grasp.

We are gradually forgetting the days when a meter supply was a box of clockwork with a very large number of separate parts. The Cauderay, Frager, Brillié, Richard Frères, and others of even more recent date, are but little used, if at all, in this country, and when tenders for meters are asked for by a municipality, four, or five at the most, well-known names appear on the list of those submitted. The gradual improvement that has taken place has been due to two influences, one the care exercised in testing and consequent value of the tests made on meters by the Liverpool Corporation, the Board of Trade, and the London County Council, to take these in chronological order; and the other the little practical points upon which makers so frequently receive hints and suggestions from users. First comes the style of meter. Many are made for fixing to the wall on battens, and the wiring is carried into the meter from the back. Others, again, have to be carried on a meter shelf, and the wiring is brought through from the bottom. This latter is, in nine cases out of ten, difficult to do neatly, and is quite unnecessary, the first method being nearly always preferable. We know of a number of places where the wiring to the meter is quite open and exposed, despite the fact that all the Fire Office rules distinctly call for some protection to the wiring throughout. Then, in certain meters, a shunt wire has to be arranged. This frequently causes trouble, and we hardly think that the consideration which should be given to this detail has been afforded it. Meter dials are now, as a rule, vertical, and the scale supposed to be direct reading in B.O.Ts. Unfortunately there are few meters to be found in a batch of one type delivered that can be trusted to read direct. A constant is then employed, much to the annoyance and mystification of the consumer, whose powers in the way of decimal notation are often very limited. Here is another argument to strengthen the hands of the reformers who would introduce the metric system into this country.

Then comes the vexed question of certification. The municipal authorities of Liverpool, County of London, City of London, Birmingham, Bath, and Toxteth, have gone to the expense of fitting up meter testing stations, and some have advertised the fact of such testing being possible pretty largely. What, however, is the outcome of all this? As the meter of a "pattern and construction approved by the Board of Trade" has yet to come for continuous currents, and, in the case of alternate supply, has only been approved provisionally on behalf of Metropolitan and House-to-House Companies in the metropolis, all such testing has a technical value only and lacks the legal importance that the Legislature intended to attach to it. The Board of Trade are very much in the position of "How happy could I be with either, were t'other dear charmer away," for we remember the uproar that ensued on their making known their intention to certify a certain type of motor meter. All other makers pressed for similar approval, and, as a result, the matter was postponed *sine die*. Still, it is not unreasonable to look for some action on the part of the Board shortly, as the time has come when the public are seriously inconvenienced by the withholding of the approval which alone can set the machinery provided by law for the purpose of ensuring accuracy in supply meters in proper working order.

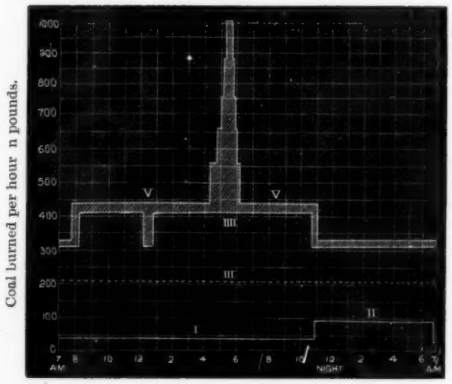
Lastly, we view with no little satisfaction the growing tendency to dispense with meter rents. One is strongly tempted to ridicule the idea of consumers having to pay rents for meters, that is, to pay for measuring a commodity which they are purchasing. But so long as the serious error remains in a meter, as typified by the tests given in another column, of reading several per cent. slow, near at or over the full rated load, one cannot be surprised that the supply concerns should be unwilling to further handicap their business by relieving the consumer and taking up themselves the burden of expense. Mr. Swinburne has systematically fought the idea that a meter with a shunt can be as good as one without it, supposing the two to be at all alike in average percentage accuracy. When one hears of the huge percentages of lost energy between the switchboard and the registered supply meter units on some stations, it makes the business mind question whether the praise showered upon electrical engineers, as a body, is not, in particular cases, rather undeserved. In capable and trained hands, electrical measuring instruments become tools of the very highest precision; but unfortunately the capability to appreciate the uses and methods of applying tests, and the skill to properly carry them out, say, as telegraph engineers have done and are doing, is sadly lacking amongst the members of the staff on many of our central stations.

FROM THE COAL PILE TO THE METER.*

By JAMES MILNE.

We see so many curves these days showing the high efficiency of this, and the very high efficiency of that, and so on, that we are apt to think there is little room for improvement. My intention is therefore to trace from the coal pile to the meter on the consumer's premises, and endeavour to show, by means of diagrams, calculated from different sources, the condition of affairs in light and power plants, and to see if there is not something that could be improved on.

Fig. 1 illustrates at a glance the following:—First, the amount of coal required to keep up the pressure at the boilers, without delivering any to the main steam pipe. It will be seen that for 16 hours about 40 lbs. are consumed, and for eight hours it takes 100 lbs. per hour; second, the amount of coal required to keep the pressure up when steam is turned on the main pipe, which is equal to 210 lbs. hourly; third, the amount of coal required to keep the steam pressure up for running the average friction load in summer. In this load I have included the power required to run the generators and charge the fields, but not supplying any current to the external circuit. Beginning at 11 p.m., we find the average friction load takes 310 lbs. per hour up to 8.15 a.m.; after that it rises to 420 lbs., and continues at this until noon. It then decreases until 12.30, and again rises, and at



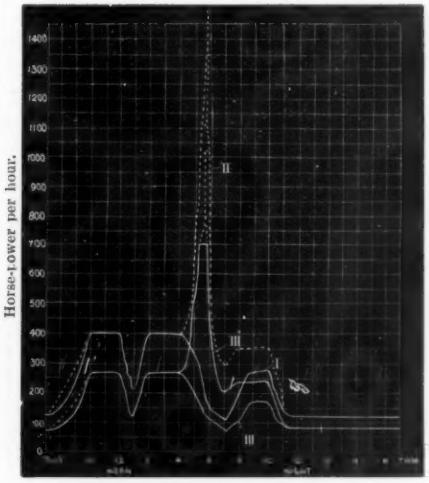
I. One boiler banked for 6 hours, 40 lbs. per hour.
II. Two boilers banked for 8 hours, 100 lbs. per hour.
III. To keep pressure up on main steam pipe, 210 lbs. per hour.
IV. Summer average, 370 lbs. per hour.
V. Winter average, 440 lbs. per hour.

Fig. 1.

1.15 it is 420 lbs., and remains at this until 11 p.m. Fourth, the amount of coal used for the average friction load in the winter time. It will be observed that for the same load there is a slight increase in the coal consumption, owing to increased radiation, condensation, &c.

We are now ready to supply current to the external circuit, and fig. 2 illustrates the power as indicated at the engine for 24 hours' run, summer and winter. Line I. shows the 1 horse-power at the engine in the summer, the dotted line the 1 horse-power in the winter, and lines III. the 1 horse-power available at the service, or when the wires enter the consumer's premises. You will observe, as the horse-power increases, the distance between the I. II. III. lines also increases. This is accounted for by the decrease in the efficiency of the external circuit, and also the increase of the friction load, and you will readily understand that when the load is at its lowest, the distance between these lines will be a minimum, and the only time they would coincide would be when the plant is shut down. The peak in the winter time is always an interesting figure to those in the business, and no doubt deserves a word or two, for it is generally about this time that a few words are said in the power house; but whether they be good or bad, I will leave that for yourselves to conjecture. I thought of plotting this peak 50 per cent. higher, but the data I have was not very reliable, so I concluded it was better to leave off at the point where it might be misleading. According to our diagram it is plotted for 1,200 horse-power at the engines, and we find, by looking at the green line, 700 horse-power are being registered at the meters, which means, by deducting the correct amount for friction, losses in generators, &c., we find a loss of 25 per cent. in the line, or in other words, we get at this time an efficiency of 75 per cent. between switchboard and meters. It may seem to you, or some of you, at least, that this is an enormous loss, and steps should be taken to reduce it. When everything is taken into account, I think we will find it cheaper to put up with this loss than try to overcome it. It (the loss) is only for, say, 60 days a year, &c., for one hour per day, making a total of 60 hours per annum. Now, if copper were put in to reduce it, we know that interest, depreciation, &c., runs on continually, and would in some cases more than offset the amount spent for the extra coal consumed during the loss. It would be an easy matter to calculate the amount spent on coal to make up this loss, and see how much copper it would be equivalent to, even taking the whole amount as interest on the investment.

On fig. 1 we showed the coal consumption per hour necessary to keep up the steam pressure to run the engines and generate current up to the switchboard. We now come to fig. 3, which shows the amount consumed when running, as indicated on fig. 2. The part in section shows the increase for the winter load, and in this we have again an interesting



Line I. = I.H.P. at engine, summer.
Line II. = I.H.P. at engine, winter.
Line III. = I.H.P. at meters.

Fig. 2.

diagram which, when calculated out, shows very clearly the effects of forcing boilers. By comparing the run made between 10 a.m. and 12 noon, and that made between 5 and 6 p.m. in the winter time, we find there is an increase of 75 per cent. in the amount of coal burned per horse-power per hour, which certainly shows that forcing boilers is far from being economical. Fig. 4 shows the amount of coal consumed per square foot of grate surface. Beginning at 11 p.m. we have 22 lbs. This continues up to 7 a.m., when a change-over is made, which reduces the amount to 9 lbs. for a short time. It then gradually increases until 10 a.m., when we get a fraction over 17 lbs. At 12 noon it diminishes to 15, and we again find at 3 p.m. it is the same as from 10 to 12, viz., 17 lbs. From 3 to 5 it averages 16 lbs., and at 6 it has reached 9 lbs. From 7 to 9 it increases from 9 to 15 lbs., and continues at 15 lbs. for 1½ hour. The part in sections, as in the other diagrams, shows the difference between the summer and winter loads. The two peaks show the amount burned per foot of grate surface on two different sets of boilers. On one it will be seen that 43 lbs. per foot are consumed and 32 lbs. on the other, and to my mind shows that they are going for all they are worth.

In calculating the amount of coal consumed per foot of heating surface, I find at the most economical load ·322 lb. is burned, and the most uneconomical load, between 5 and

* Read before the Canadian Electrical Asscciation, Ottawa, Ont., September, 17th, 1895.

6 p.m. in the winter, it is as high as 9 lbs. per square foot. Let us now see what economy we are getting from the boilers.

Summer: Total water evaporated for 24 hours = 201,600 pounds.

$\frac{201,600}{25,000} = 8{\cdot}07$ lbs. water evaporated from temperature of feed or 210, which is equivalent to 8·32 lbs. from and at 212° per pound coal. Allowing 10 per cent. ash, which is not excessive, and compares favourably with the average of the data I have received from different plants, we get 8·97 from temperature of feed, or 9·24 lbs. from and at 212° per pound combustible.

Winter: Total water evaporated per 24 hours = 276,343 pounds,

$\frac{276,343}{36,000} = 7{\cdot}5$ lbs. from temperature of feed or 200°, which is equivalent to 7·9 from and at 212°, and allowing the same percentage of ash, we get 8·34 lbs. from 200°, and 8·78 lbs. from and at 212° per pound combustible.

In the summer time, we have stated, that an evaporation of 8·32 lbs. per pound of coal is obtained, and taking the coal at 12,875 B.T.U., we get a theoretical evaporation of 13·32 lbs. water per pound of coal from and at 212°. This agrees fairly well with any of the tables giving the thermal units of heat of the grade of coal burned.

Theoretical evaporation = 13·32 lbs.; actual evaporation = 8·32. Efficiency therefore is = 62·47 per cent., or, say, 62·50.

We are all more or less acquainted with the first law in thermodynamics, which may be stated thus:—Heat and

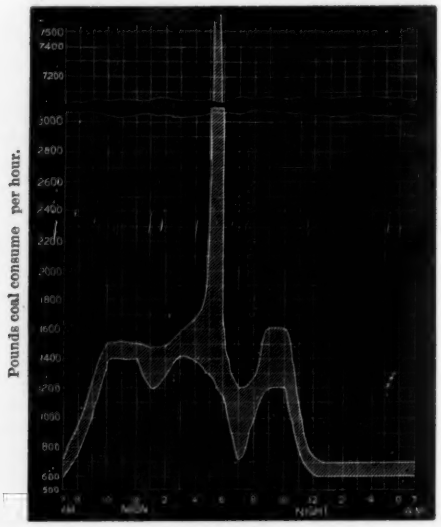


Fig. 3.

mechanical energy are mutually convertible, a unit of heat corresponding to a certain fixed amount of work called the mechanical equivalent of heat. We can calculate the mechanical equivalent of the coal pile thus:—

$$\frac{12,875 \times 772 \times 25,000}{24 \times 60 \times 3,300} = 5,229 \text{ horse-power.}$$

$\therefore 5,229 \times {\cdot}6247 = 3,262{\cdot}5$ horse-power available at the stop valves of the boilers, which, if all were utilised, would give us 3·1 horse-power per pound of coal per hour, or a little over ·31 lb. coal per horse-power per hour, a result which, with the greatest refinement in engineering, has not yet been attained in practice, and, I think I am safe in saying, never will.

We will now calculate the efficiency of the steam:—

Average steam pressure ... ... 125 lbs. absolute.
Average exhaust pressure ... 20 lbs. „
Water per horse-power per hour 28 lbs.
Temperature of feed ... ... 210° Fah. (Summer.)

Temperature of water before entering heater, 40°. 125 lbs. abs. = 1,187 units. Feed water raised from 40° to 210° = 170° by heater

$\therefore 1,187 - 170 = 1,017$ thermal units of heat expected per pound of steam.

Thermal units per 1 H.P. per minute $= \frac{1,017 \times 28}{60} = 474.$

$$\therefore \frac{42{\cdot}75}{474} = {\cdot}09 \text{ or } 9 \text{ per cent. efficiency.}$$

Taking the temperature of the feed at 210, and that of the steam at 344°, we get

$$\frac{344 - 210}{805} = {\cdot}168, \text{ or an efficiency of } 16{\cdot}8 \text{ per cent.}$$

if same were a perfect engine working between the limits of the temperature 344° and 210°. Therefore the relative efficiency between the perfect engine and the above is

$$\frac{{\cdot}09}{{\cdot}168} = 53 \text{ per cent.}$$

By the above reasoning we get an efficiency of 9 per cent. of the total power available at stop valves of boilers:—

$$3266{\cdot}5 \times {\cdot}09 = 293{\cdot}98 \text{ H.P.}$$

our actual H.P. is 230 or 78·23 per cent. of 293·98.

$\therefore {\cdot}9 \times {\cdot}7823 = {\cdot}070407$, or a fraction over 7 per cent. represents the efficiency of engine to boiler, and calculating to coal pile, we get an efficiency of $·625 \times ·09 \times ·7823 = ·625 \times ·070407 = ·044$, or a net efficiency of 4·4 per cent.

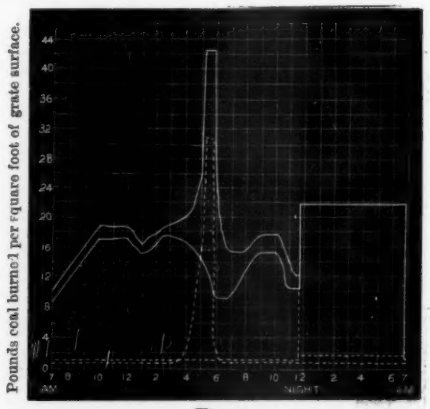


Fig. 4.

We also find from actual results that a mechanical efficiency of 82·3 per cent. is obtained from the engines; that is to say, it takes 17·7 per cent. to overcome friction and run generators up to speed.

Therefore the power available for running the generators is

$$230 \times {\cdot}823 = 189{\cdot}29 \text{ H.P.}$$

Efficiency of generators not less than 92 per cent.

$\therefore 189{\cdot}29 \times {\cdot}92 = 174{\cdot}14$ H.P. available for sending out to the line, and from boiler to switchboard, we have

$$·09 \times 7{\cdot}823 \times {\cdot}823 \times {\cdot}92 = {\cdot}0533;$$

or, briefly, $\frac{174{\cdot}14}{3,266} = {\cdot}0533$, or $5\frac{1}{3}$ per cent. efficiency, and going back to coal pile we get $·0533 \times ·1247 = ·0333$, or $3\frac{1}{3}$ per cent. efficiency.

We have got one more item to take into consideration to complete our calculations, and that is the efficiency of the external circuit, which is in the summer time 85 per cent. Therefore, the total horse-power available at the meter on the premises of the consumer is $174{\cdot}14 \times {\cdot}85 = 147$ horse-power fully, or, more accurately, $3,266 \times {\cdot}09 \times {\cdot}7823 \times {\cdot}823 \times {\cdot}92 \times {\cdot}85 = 148$ horse-power.

The net efficiency from boiler to meter is

$$\frac{148}{3,266} = {\cdot}0453 \text{ or } 4{\cdot}53 \text{ per cent.,}$$

and from coal pile to meter we get $·0453 \times ·6247 = ·0283$ or 2·83 per cent.

From the above we get the following results:—

Power for running generators	100
„ available at switchboard	92
„ „ at meter	78·20

Efficiency of the electrical apparatus, including outside circuit = 78½ per cent.

Engine	100
Available for generating current	83·3
„ at switchboard...	75 72
„ at meter	64 35

The commercial efficiency from engine to meter is 64·35 per cent.

Boiler equivalent	100
Indicated horse-power at engines	7·04
Available for generating current	5·79
„ for switchboard	5·33
„ at meters	4·53

The efficiency, therefore, from the boilers to the meter, is 4·53 per cent.

Coal pile equivalent	100
Available at stop valves of boiler	62·47
Indicated horse-power at engine	4·4
Available for generating current	3·62
„ at switchboard...	3·33
„ at meter	2 83

The above extended results apply, as has already been stated, to the summer load, but as the results from the winter load are practically the same, I need not take up your time going over them.

We see, therefore, that the electrical end shows up exceedingly well. For every 100 horse-power at the engine, 82·3 are utilised for generating current, and 75·77 of these are sent out to the line, which, although it could be improved on, leaves very little to be gained by any new invention or alteration that may hereafter be made.

Regarding the steam end, there can be no doubt that considerable attention has been paid to it, and it is still receiving more. Yet it does not alter the fact that it is here where we get the worst showing. When some of the great scientists arrive at the method of abstracting electricity direct from the coal pit, or even the boiler, without the intervention of the steam engine, better results may be obtained.

I see in some of the engineering papers that evaporation condensers are coming into use, and are being applied to plants that have heretofore been running non-condensing. This is a step in the right direction, and as no more water is used than that required for steam purposes, parties at present having to pay for their water might find this a profitable investment, inasmuch as a vacuum of from 22 inches to 26 inches is readily obtained; in fact, guaranteed by the builders.

ELECTRIC ROAD CARRIAGES.

M. Rechniewski contributes to *L'Electricien* an account of the vehicle built by M. Jeanteaud, which ran the Paris-Bordeaux race without serious accident. He says that electrically propelled carriages are, nevertheless, yet only in their experimental stage. From the drivers point of view the electric carriage has the most convenient and manageable motor and leaves nothing to be desired on this count. Its most inconvenient feature is that it is necessary to seek a charging station after running a certain course for the purpose of being recharged or of a change of cells, an inconvenience less serious for certain services than for others, as, for instance, when a carriage runs between certain fixed points or stations. The first item to be considered is the distance that can be run on one charge; the second item is the possible running speed. Among the many accumulators tried up to date for road vehicles, those of the Fulmen type have given best results, and the arguments of the article are based on the figures obtained therewith. The batteries used on the Paris-Bordeaux route weighed complete 850 kg., and had 38 elements of C 21 type divided into a dozen boxes of 3 or 4 elements each. Each element had 15 kg. of electrodes and a capacity of 300 ampère hours at the ordinary rate of discharge of 10 hours. At a discharge of 70 ampères, nearly 5 per kilogramme of plates, the capacity of the battery would be still 210 ampère hours. Unfortunately, the mean power at the 10 hours' duration of discharge is fixed a trifle low, and the length of the road between charging stations is thus very important. As the electrical carriage bears its own battery, and this is limited in its storing power, the question of weight and efficiency are of special importance, and it is desirable to reduce weight to a minimum.

The vehicle of M. Jeanteaud at present holds the record for speed and distance among its electrical competitors. It is a plain vehicle with no offensive pretence in the shape of a dummy animal in front; it has two parallel seats, each of two places, and a back to back seat at the rear and provided in front with a circular splash guard carrying a triple bulls-eye lamp. The accumulators are placed beneath the rear seats. The wheels are of hickory, 1 metre diameter in front and 1·40 metre behind, and they carry respectively 1,200 and 2,000 kilos, or a total of 3,200 kilos, or fully 3 tons.

The front end is supported by two bow springs set transversely one above the other and coupled back and back, so giving the effect of a central support to the body of the carriage and halving the effect of a stone or lump under either wheel as well as giving a very elastic suspension and easy running. The body of the vehicle is entirely of steel. The axles have bearings of 45 and 55 millimetres at the front and rear; on the day of the race an accident bent the rear axle which ran hot all the time and compelled stoppages continually for cooling and oiling, and when examined at the journey's end, the axle box was proved to have seized badly, and to this common accident the delay of the electrical carriage was entirely due. There is a brake on the wheel tyres actuated by a pedal and another brake worked by wheels at each end of the seat for use in case the driving chain broke upon an incline, the two brakes giving absolute security in the working of the machine.

The mechanical arrangement consists of a shaft carrying differential gear driving the wheels by two chains, the gearing permitting speeds of 12 and 24 kilometres per hour at the ordinary speed of the motor.

A "*Bovet*" magnetic gear was intended for changing the gear, but at the last momant, not being ready, had to be replaced by an ordinary clutch.

The motor built by the Société Postel Vinay has given excellent results, both on a brake test and over the course of 600 kilometres, which it ran without a failure, and so takes a position in advance of anything yet tried. Its efficiency was over 90 per cent. when working at a voltage of 70, and nearly 7 horse-power with 70 ampères. This is necessary for the traction at the rate of 24 kilometres. The weight of the motor is 225 kilos., and it develops 14 or 15 horse-power when surmounting hills without heating or sparking, and it acts as a dynamo or brake in descending hills to the extent of 80 ampères. Though too little to be taken into account, it is enough to secure excellent regulation in descending hills. The intended output of 70 ampères has frequently been doubled, and even 200 have been drawn for an appreciable time without lowering of the voltage. In spite of such enormous outputs, of frequent journeys by rail of some of the batteries returned to Paris to recharge, and sent on again to Bordeaux, of hasty transhipment and frequent operations by unaccustomed hands, and of shaking on the road, these batteries have behaved well and kept their charge. Each battery of 850 kilos. served for a run of 40 to 70 kilometres, according to the nature and profile of the route. Ten minutes served to change them at the stations, and the reconnection is automatic by means of springs and metal plates.

It was only in March, three months before the race, that the construction of the carriage with its motor and battery was commenced, and only one trial was made prior to the race of June 6th, and except for the heating of the one axle, no part of the vehicle or of its machinery called for the slightest repair during the run of 600 kilometres, as is proved by its return to the exhibition after the journey.

Messrs. Jeanteaud et Brault aimed less at the prize than at demonstrating that electricity has entered the practical stage in road traction, and we can only regret that the unfortunate accident to the axle should have prevented the vehicle from showing what would surely have been even a much better record. At the same time, the weight of over three tons should be kept in mind as something to be, if possible, reduced, as it is a great bar to the success of accumulator propelled carriages for general work.

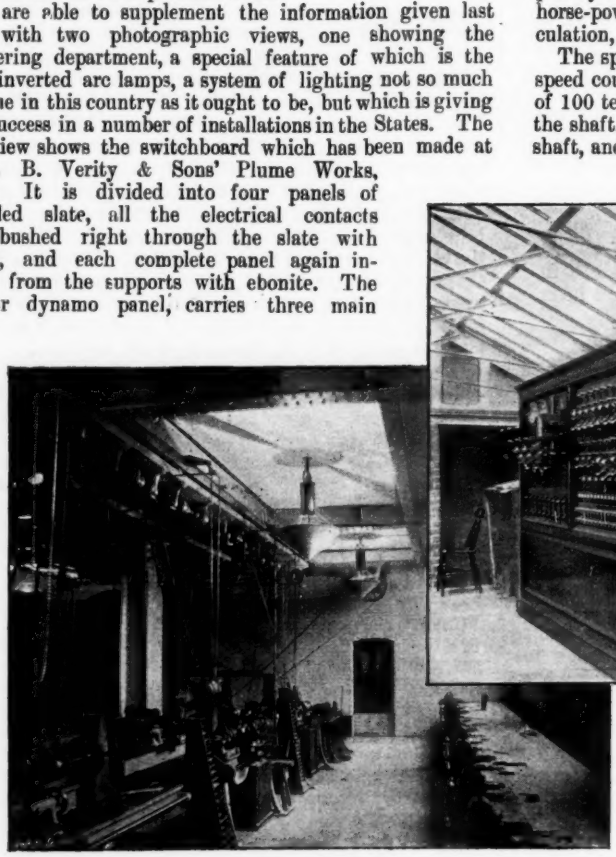
THE ELECTRIC LIGHTING OF BIRMINGHAM TECHNICAL SCHOOLS.

In our last issue we published some details regarding the somewhat extensive lighting and power installation, which has recently been introduced into the Birmingham Technical Schools for the City Council. Our readers will probably remember that the contract was first awarded to a Glasgow house, but, after a few weeks, the trustee of the business under sequestration had declined to fulfil the contract. The matter had, in consequence, to be again considered by the Council, with the result that Messrs. B. Verity & Sons were instructed to provide plant for the new schools for the sum of £5,714 odd.

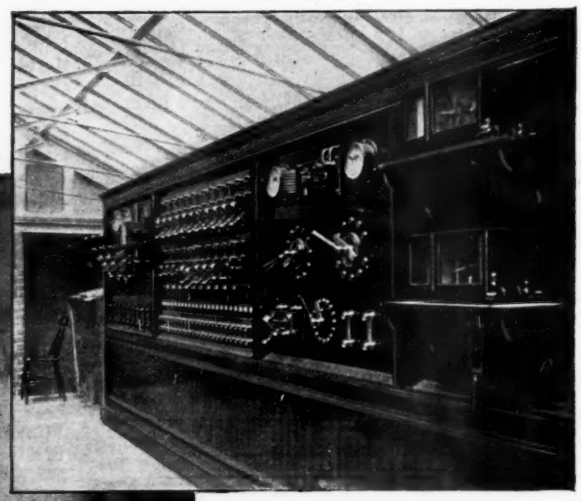
In less than four months the work was completed, and a few weeks ago the schools were opened, the light being used for the first time on September 16th.

We are able to supplement the information given last week, with two photographic views, one showing the engineering department, a special feature of which is the use of inverted arc lamps, a system of lighting not so much in vogue in this country as it ought to be, but which is giving great success in a number of installations in the States. The other view shows the switchboard which has been made at Messrs. B. Verity & Sons' Plume Works, Aston. It is divided into four panels of enamelled slate, all the electrical contacts being bushed right through the slate with ebonite, and each complete panel again insulated from the supports with ebonite. The first, or dynamo panel, carries three main double pole switches, one to each dynamo, three balancing wire or "paralleling" switches, each being interlocked with its respective main switch, three ammeters, one of Lord Kelvin's voltmeters and voltmeter key, three shunt resistance switches, and the necessary fuses. The second panel has the usual positive and negative omnibus bars, and 23 circuit switches and fuses. The third, or accumulator panel, is fitted with an ammeter and voltmeter, a Neville automatic cut-out, charging and discharging switches, and a resistance switch for starting the transformer. The fourth panel has on it a recording ammeter and recording voltmeter by Richard Frères, and a change over switch.

The whole is mounted in a framework about three feet from the wall, neatly faced with polished wood, and it is an exceedingly creditable piece of work.



Engineering Department, Lighted by Inverted Arcs.



Switchboard.

The Institution of Junior Engineers.—On Friday, November 1st, 8 p.m., at the Westminster Palace Hotel, the Presidential Address will be delivered by Mr. Archibald Denny, M.I.N.A., of Dumbarton.

HOW TO TEST A TURBINE.*

By SAMUEL WEBBER.

(Concluded from page 479.)

Although accuracy is the soul of engineering, there is no use to waste time and money in pursuing it to a point where it is utterly worthless. Therefore, I adopt now, where possible, the length of brake levers stated, and if a bell crank be needed, as in a vertical wheel, I make the arms either of equal length, or as two to one. Then, if the revolutions per minute of a 33 feet circle are taken, multiply their number by the weight in the scale, strike off three decimals and you have the horse-power; multiply that by 2 or 3, if you use a 66 or a 99 feet circle. If the 55 feet circle be most convenient, take the number of seconds occupied in making 100 revolutions and divide the pounds in the scale-pan by them; multiply the result by 10 and you have the horse-power at once. Make your machinery do its own calculation, and you will save fatigue and error.

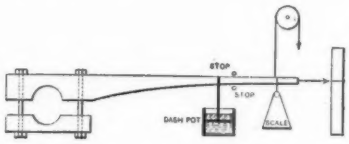
The speed of the shaft is best ascertained by the automatic speed counter, consisting of a short worm shaft, with a gear of 100 teeth, which strikes a bell at every 100 revolutions of the shaft. This can be tapped into the end of the wheel shaft, and the plate which holds the bell kept from turning round by a wire tied to any convenient stay. Have your weights clearly marked beforehand in black on white, or white on black, so that you can see at once what weight you have on the scales.

The dash-pot, or regulator, is to steady the motion, and consists of either a cylinder or a square box, filled with water, and fastened to some support under the scale-beam, so that a piston, $\frac{1}{8}$th inch less in diameter than the box, may move freely up and down in it, except for the resistance of the water. A very good proportion for this is one square inch area for each horse-power to be controlled. The dash-pot may be at the opposite end of the scale-beam from the weight pan, and may help to balance it, but there are occasions in which it is impossible to use a beam like this, and the form of a bell-crank has to be adopted. In such a case it may be placed on the same side as the weights, and the whole balanced off by a weight over a pulley hung from the floor above.

A wheel on a horizontal shaft only needs the leverage of the brake itself, which should be balanced off in the same way when all is ready, before testing, with the scale-pan hung on, the piston also hung, and the dash-pot filled with water, so that the whole apparatus, exactly as it is to be used, is perfectly balanced before commencing operations. On the horizontal shaft, the lift will, of course, be perpendicular, but the knife-edged eye bolt, from which the scale is hung, should

* *Cassier's Magazine.*

stand exactly level with the centre of the shaft. With the vertical shafts the line of pull on the scale-beam should be exactly perpendicular to a line drawn from the centre of the shaft to the eye bolt on which the weight is hung. With the apparatus on a vertical shaft the weight of the friction pulley will usually be about equal to that of the bevel-gear, whose place it takes, but the brake should be suspended, so that its weight will not bear on the wheel-step, and a rope should also support the extreme end of the lever, particularly if it is a long one, and be attached to a hook or bolt directly over the eye bolt when in a working position, so as not to give any lateral strain on the lever.



Making the Adjustments.

The brake on a horizontal shaft should be lifted off of the pulley after all the adjustments of position are made and balanced over an edge, with all its appurtenances, and the piston in water in the dash-pot. This is done by a weighted rope or band passing over a pulley above, and this pulley should be large enough and move freely on its axis, so that a spirit level, placed centrally over the point of balance on the pulley, will show the least weight added to the end of the lever. All pivots taking a strain should be "knife-edged," like the fulcrum of a steelyard.

The extreme end of the scale-beam should be provided with a pointer, working against a board on which a black line on white, or *vice versâ*, shows the exact point of level, and strong stops must be placed above the scale-beam, and also below, so as to prevent it from moving more than 3 or 4 inches from the line. This line should be in clear sight of the "man at the helm," or the one who operates the screws of the brake, and he should aim to keep the pointer on the line, and all tests should be rejected in which the lever rests on either stop.

I have spoken of length of brake lever, and recommended a radius which would give a circle, of which the circumference would be the integral part of a horse-power. If you cannot do that, get, if possible, the radius of a circle of even decimals of feet, say 20, 30, 40, &c. It is much easier to make your lever the radius of an even circle, to start with, than to make it even feet, and have to multiply it by 3·1416, and use a lot of decimals in all your future calculations. You will sometimes have to yield to the circumstances of the situation, as the writer did in the case of the heavy test just spoken of, where he tried to get the radius of a 99-foot circle, but was obliged by a lot of iron columns and beams to use one of 14 feet 9½ inches, or the radius of a circle of 92·941 feet, and had these decimals to handle at every calculation. As his best test was made with 1082·5 lbs. in the scale, at a speed of 400 revolutions in 315 seconds, or 76·19 revolutions per minute, the number of superfluous decimals to be handled is readily seen.

With all these points adjusted, if the test is for power only, we are ready. One man must handle the wrench at the brake, with his eye on the scale-beam pointer, and so control the piston as to keep it on the level line; another assistant must attend to the lubrication, and keep a steady flow of soap and water on the pulley; while the observer, having placed a certain weight in the scale, must time the revolutions of the shaft, and while he does this, he must also keep one eye on the pointer at the scale-beam, to be sure that the brake is working properly.

The writer usually gets the proposed revolutions of the shaft, and the assumed power of the wheel, beforehand, and from them calculates the necessary weight in the scale to produce such result. He then begins by placing in the scale a weight, say 25 per cent. less than the one assumed, and counts the revolutions, and if they are too high, adds 5, 10, 15 or 20 lbs., as may be, to the load, and repeats this until the best point is passed, and the power decreases. This best point may be at the speed recommended by the builder, or it may be not; the writer has found it uncertain. If the scale-beam, as advised, represents the integral circle of 1 H.P., the calculations necessary to determine results are very easily and rapidly made as the test goes on, and when the best point is closely ascertained, a more definite result may be reached by less changes of the weight, and very careful noting of speed to half-seconds.

With these instructions and precautions the writer believes he has covered all the points necessary, if the actual working power of the wheel is all that is needed, but if the consumption of water and "net effect" are also desired, the following additional steps must be taken. A weir must be built across the tail race, far enough below the wheel to ensure still or quiet water, and if not so within a short distance, it may be obtained by passing the water through a rack. This weir should have a sharp and level crest, say ⅛th inch thick, with end pieces of the same, set perpendicularly, an even number of feet apart, and all bevelled away on the down-stream side, so that the water touches only the up-stream edge.

This weir, according to Mr. Francis, should be of such height that the depth of the water in the race above it should be at least three times that of the body passing over the weir, and there should be a clear fall over it, so as to admit of a free passage of air under the sheet; beyond this, the depth of the fall makes no difference. The depth of the water on the weir is not measured at the weir itself, but preferably by a pipe taken out from above the weir, and leading into a box below, in which a hook gauge is set.

This, as shown in the illustration below, consists of a bronze or copper rod, from 2 to 3 feet long, having a needle pointed steel hook at its lower end. It is graded in feet and hundredths, from zero at the upper end down to the point where the hook is attached. A vernier, fastened to the board to which the gauge is attached, enables the reading to be taken to thousandths of a foot. This board should be supported in a proper position, at such a height that, with the point of the hook just level with the top of the weir, the zero of the rod should agree with that on the vernier.

Then, when it is raised, so that the point of the hook just dimples the surface of the water, the depth of the water is read at the vernier. This was the invention of Uriah A.

A Hook Gauge.

Boyden, to avoid errors from capillary attraction. The level of the water in the box will agree with that above; or, the box, having a perforated bottom, may be inserted in the channel above, at least 6 feet above the weir. At the Holyoke testing flume, the hook gauge is permanently set below the weir with its point on an exact level with the top of the weir, and the water is brought from above through a flexible pipe into a tin can, supported by cords over pulleys, which can be raised to agree with the height above, so that the water will be nearly at the top of it, and the hook-gauge raised until its point just breaks the water, which in this way can be seen very distinctly.

Mr. Francis, in his "Hydraulic Experiments," gives a full table of the cubic feet of water per second passing over a weir, 1 foot long, at all depths below 3 feet, without contractions, and from this have been computed the cubic feet per minute over weirs of various lengths with end contraction up to 20 feet for all depths below 2 feet. These calculations the writer has carefully examined, and having found them to be reliable can recommend them. They are published by James Emerson, Willimansett, Mass., in his "Hydrodynamics," which also contains Mr. Francis's tables above noted, and valuable tables of the velocity of water under heads up to 500 feet.

Another observer is necessary at this hook-gauge, who should ascertain the depth of water passing over the weir every half minute while the power tests are being made, and the watches of both observers should be set together, so that the proper calculations may be made correctly. The end-pieces which determine the length of the weir should also be

set out a foot or more from the walls of the race, so as to ensure perfect contraction, without side friction. Should there be any decided velocity in the water approaching the weir, an addition must be made for that, but as this is not a treatise on hydraulics, the writer will only refer to the well-known formulæ of Mr. Francis, merely saying that Mr. Francis found a velocity of approach of 6 inches per second to give an increase of volume of 1 per cent., and a velocity of 1 foot per second of 2 per cent. If the books referred to are inaccessible, it is well to remember that nearly all the turbine builders now publish rules and tables for measuring water in their catalogues. Should the flume gates leak, or there be any other waste water flowing over the weir, the height on the weir of this water must be first taken, and the volume ascertained from the tables to be deducted from the final result. It will not be correct to subtract the height and calculate from the remainder.

When the volume of water per minute or second has been ascertained from the weir tables, multiply this by the height of the fall, and, again, by 62½ lbs. for the weight of each cubic foot of water, which is more near the average weight than the 62½ lbs. usually assumed. Divide the total by either 33,000 or 550, as the flow is taken in minutes or seconds respectively, and you have the gross horse-power of the water. By this divide the power attained by the turbine, and you have the net effect of the wheel.

Finally, to get the actual head on the wheel, a very convenient plan is to get a tin can 3 or 4 inches diameter and a foot long, with a bottle neck. Into this fasten securely, and so as to be air-tight, a slender pine rod 1 inch wide, and ¼ inch thick, and a little longer than the height of the fall. Drop this into still water perpendicularly so it will float. Mark the line of flotation, and from that graduate the rod upward in feet, numbering each foot, and for the last few feet near the top, or head water level, sub-divide each foot into graduations of tenths and hundredths. Make a wooden box, a little larger than the can, open at each end, and a little longer than the depth of water in the pit. Nail slatts across the bottom, so that the can will not fall through, and fasten this to the side of the pit, so as to go well below dead-water level. Drop the can into this with the rod coming up through the floor into the wheel room. Tap a pipe into the feeder or forebay, with a flexible connection and a glass tube, a foot or more long at the end of it, and place this glass tube by the side of the float rod. The graduations on the rod, against which the water level from the forebay in the glass tube stands, will give the exact head acting on the wheel when running. The writer has put in a number of these "head-gauges" in various mills, and in almost every case the mill owners have kept them in place as a correct record of the head acting on their wheels at any time.

There is but one thing more to be said :—In making such a test your weir has, of course, reduced the normal head on the wheel, and to get the final result to the mill owner, the weir must be taken away, and the head taken under usual conditions. From the velocity tables referred to, calculate the volume of water which would pass under the full head; multiply this by the real head, and, again, by 62½ for the gross power of the water, and take the same percentage of net effect of that which you have found by your test, and you will get the real value of the wheel to the mill owner. In the case to which I referred at the outset, the mill owner, under the full head which he expected, would have really got 534 H.P. instead of 472 from each wheel.

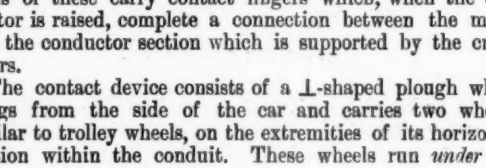
Contingencies may arise, in which none of the suggestions made above will be available, but an ingenious mechanic will usually be able to find some way to accomplish the desired result. The writer once had to test a turbine from a horizontal shaft, running close under a floor, with no cellar room below, and had to cut a hole through the floor, and set his brake lever perpendicularly above the shaft, and then pull on a "bell-crank" scale-beam! He hopes, however, that the article may prove of value to the younger members of the profession.

A NEW CONDUIT RAILWAY SYSTEM.*

We illustrate herewith a new conduit railway system which possesses several points of novelty and ingenuity; the system is being exploited by the La Burt Electric Railway Company, 123, Liberty Street, New York, and is the invention of Mr. John La Burt, the company's engineer. It belongs to that class of conduit railways in which the working conductor is sectional, the sections being connected with the supply mains only when cars are over them. The La Burt system, however, differs radically from others of this general class in that there are no magnetic switches or contact-making devices, the working conductor being put in and out of circuit in a very simple and ingenious manner, described below.

The conduit is located just outside one of the rails and contains only one conductor, the rails being used for the return, as in the trolley system. The conductor, as above stated, is sectional so far as conducting material is concerned, but the ends are mechanically joined by a non-conducting and flexible device which behaves exactly as a universal joint. Each section of conductor is supported, at the ends only, upon the arms of two bell cranks; the other arms of these carry contact fingers which, when the conductor is raised, complete a connection between the mains and the conductor section which is supported by the crank levers.

The contact device consists of a ⊥-shaped plough which hangs from the side of the car and carries two wheels, similar to trolley wheels, on the extremities of its horizontal portion within the conduit. These wheels run *under* the



Sectional End View at Contact Box.

sectional conductor and raise each section of it as they reach that section, completing, by means of the bell-crank levers, connection between the sectional conductor and the mains. As the car passes beyond a given section, the contact wheels being no longer beneath it, that section drops down, cutting itself out of circuit.

The sections are made sufficiently long to insure the dropping of one end while the other end is held up, the flexible connections between the individual sections permitting this action. Therefore, as the car comes to a section only the nearest end of the conductor-section is raised, the bell-crank at that end putting it in circuit; when the car is over the middle of the conductor-section, the far end will have been raised and an additional contact made there, the conductor-section being made of pipe to secure the proper rigidity. As the car moves farther and farther from the first end of the section, that end sags and finally drops to its lowest position just before the contact wheels reach the far end; as there is a contact at this end, the breaking of contact at the end in the rear of the car produces no spark. In raising the far end of the live section under the car, the near end of the section just beyond is raised, so that when the contact wheels pass from a given section, the section beyond is in circuit and ready to supply current. The two wheels of the contact device are placed sufficiently far apart to straddle the break between sections and obviate any sparking there.

The plough also carries a circular wire brush, as shown in the engraving, which is set at such an angle that the friction against the sides of the conduit causes it to revolve and clean the walls of the conduit as the car passes along.

The contact plough is movable vertically on the car truck, but is normally held up by a strong spring. In the event

* *Electrical World*, New York.

that it should become desirable to remove the contact wheels from the conductor the motorman can depress the plough, allowing the sectional conductor to break contact with the mains, and also dropping the contact wheels from the conductor entirely.

At each break in the working conductor a contact box is located, access to which is readily had by removing the cover, which does not involve the removal of any pavement or the disturbance of the track or conduit structure.

THE LIGHTING OF NEWPORT.

The Newport Corporation Electricity Works have been opened. The contracts were made nearly two years ago, and as such a period constitutes an age in electric lighting, the Newport Works were somewhat old fashioned at their inauguration. Rope driven alternators are hopelessly out of date; they may continue to turn round occasionally, but they are quite out of step with modern practice. Newport is a replica of Burton, Leeds, Blackpool, and numerous other places, and Mr. Robert Hammond is the engineer. Mr. Hammond has shown great faith in horizontal rope-driven plant, and horizontal plant has shown great faith in Mr. Hammond. It will be seen from our illustrations that four horizontal engines drive four alternators. The engines are each of 150 I.H.P., and the alternators have each a capacity of 75 kilowatts. The engines, which are of the compound condensing type, have been manufactured by the Uskside Engineering Company, and the alternators, which are of the well known Hall type, have been made by Messrs. Fowler and Co. The working pressure of the engines is 125 lbs., and the speed 110 revolutions per minute. The fly-wheels of the engines are 12 feet in diameter, and weigh over 8 tons each. The Hall machines are very much what we have described before. The armature is stationary, the moving parts of the machines being the field-magnets. They have a periodicity of 87, and voltage of 2,000. The switchboard comprises the usual measuring instruments and the heavy plug switches much used in this class of station. The only point of interest about the plant is that which has been set apart for day-load purposes. Its importance is put so high that it is placed in a separate building. It consists of a semi-portable undertype engine and boiler combined, which gives power to drive a Hall's combined alternator and exciter fixed on one bedplate.

General View of Newport Works.

There are four Lancashire boilers working at a pressure of 125 lbs.; they are fitted with Meldrum's system of forced draught, and are supplied with Proctor's mechanical stokers. In connection with the steam-raising plant are three Berryman feed-water heaters and three duplex feed pumps. As the engines work condensing, a Worthington self-acting jet condenser is used.

The distribution of low pressure current is done from street transformer boxes, put underground at distances of 200 yards apart. The high-tension cables are of vulcanised India-rubber and drawn into cast-iron boxes and culverts. The transformers are of the Lowrie-Hall pattern, which are placed in cast-iron boxes.

The street lighting, which is done by alternating current lamps, is not very extensive at present; 40 Lewis lamps of 2,000 C.P. have been erected. This type of lamp was described in our issue of June 29th, 1894. The transformation of the primary current is done by small converters in the base of the lamp posts.

THE HOOKHAM ELECTRICITY METERS.

(*Continued from page* 477.)

The importance of the modifications, or, rather, radical alterations, that have been introduced into the Hookham continuous current meter can best be appreciated by referring to a test of the old commutator pattern, made by Mr. J. H. Yonge*, in which it was found that:—

With pure mercury in cups.	With commercial mercury in cups.
Starting current, 1 ampère,	3·5 ampères.
3 per cent. load, 17 per cent. low,	—
20 per cent. load, 9 per cent. low,	—
50 per cent. load, 4 per cent. low,	—
100 per cent. load, 1 per cent. low,	8 per cent. low.

Nominal full load of meter, 100 ampères.

Experience has proved that pure mercury, when exposed to the air and subjected to the amalgamating influence of masses of copper, rapidly becomes what could only be classed as commercial. Against such a test as the above must be placed those we have now to briefly discuss.

A curve is here given showing the results found with a 50-ampèremeter on test. From this, the meter is seen to start with a very small current, and at less than one-twentieth of its full load is within 2 per cent. of correct integration; throughout the proper range the plus error is never more than 1 per cent., while at the upper limit the readings are very nearly true. Beyond this point the error would become minus, and read, therefore, against the supply company, as the magnetic shunt would be unable to fully compensate for the increase in fluid friction.

Mr. James Swinburne tested the Hookham meter a short time ago, and, in his report, designated the instrument "a single conductor, or, as it is incorrectly called, a uni-polar or non-polar motor, with its armature in the main circuit, and a permanent magnet field." The tests were taken on eight meters, three being sent by the makers and five selected from stock. The maker's usual tests at $\frac{1}{20}$, $\frac{1}{2}$, and full load agreed with Mr. Swinburne's at 2, 4, 6, 8, 10, 15, 20, 50, 70, and 100 per cent. of the rated load. All read slow at very small loads. Evidently Mr. Crompton's theory does not apply to this pattern. Mr. Swinburne attributes the minus error to pivot friction, a source of error that seems unavoidable; in fact, he considers that an attempt to correct it by giving a slight permanent torque may lead to a much more serious error by the meter continuing to work after the load is off. He summarises the advantages by saying that the absence of a shunt circuit is most important, as, at 2d. per unit, every watt lost in a shunt circuit is equal to the interest on £1 at 7 per cent. The meter is durable, of low resistance, permanent, and, according to the makers, the temperature error cancels out even if the special alloy be not used for the brake disc.

Starting Currents.

Mr. Swinburne, 0·15 amp., 0·17 amp., 0·32 amp. Size not stated.
Mr. Crompton, 0·15 at 0·33 amp., 23 per cent slow. 25 amp. size.

* *Proc.* Inst. C.E., cviii., p. 366.

The foregoing summarises the tests of starting current in the reports before us. The second is of recent date, and includes the observations made by Mr. R. E. B. Crompton on three 25-ampèremeters tested by him during a period of three weeks. The maximum errors are:—

3·26 per cent.; 3·8 per cent.; 2·6 per cent. from mean reading of each meter.

which is considered to be "a very high degree of accuracy."

It was found that on reversing one of the meters, and again sending the current through it in the normal direction, there was no alteration in its calibration. With one meter the reading had to be divided by 0·957 to give correct ampère hours, and the maximum error occurred at 17 ampères,

Percentage of full load.

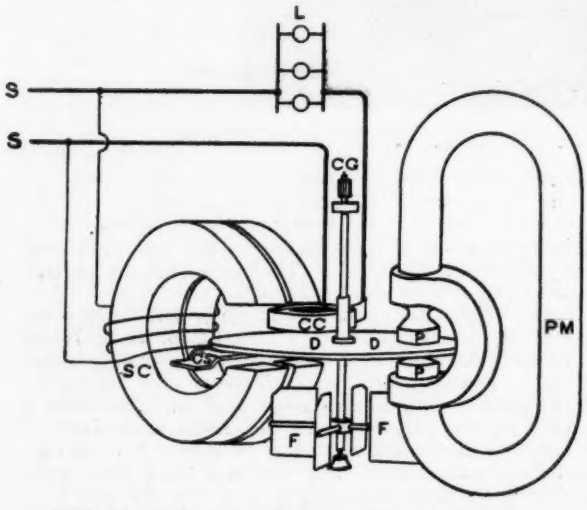
Continuous Current Meter Curve.

where it was 3·26 per cent. slow. This is a larger error than one would care to have at 17/25 of full load, and is in the wrong direction. The second meter had a constant of 1/1·032, with a maximum minus error of 3·8 per cent. at 5·6 ampères—altogether a better result than the first; while the constant of the third was 1/1·026, the maximum error, minus and 2·6 per cent. at 5·4 ampères, this being the best instrument of the three submitted.

Mr. Crompton has expressed his opinion of the value of the meters in an interesting and rather novel way. He says that:

1. If used for metering the energy to an ordinary dwelling house, in which the average annual use varies from 15 to 30 Board of Trade units per lamp fixed, these meters would register 98·6 per cent. of the energy actually supplied.

2. While if used for measuring the energy to shops, warehouses, or other premises in which the average annual use varies from 30 to 60 Board of Trade units per lamp fixed, these meters would register 99·4 per cent. of the energy actually supplied.



s, Supply mains; L, Lamps; P M, Permanent magnet; C G, Counting gear; S C, Shunt coil; C S, Copper shield; C C, Current coil; P, Poles; F, Fan; D, Disc.

Alternate Current Hookham Meter.

He lays stress on the fact that in both these cases this accuracy can be obtained without setting the meter to read against the consumer at any part of its range.

As regards the means by which this degree of accuracy has been obtained, Mr. Crompton thinks it is chiefly due to the way in which the static friction difficulty has been dealt with, and to this he attributes the good starting power at low loads. He also expects constancy in working, since the forces which keep the parts in motion are large in comparison with any frictional resistance in the moving parts which may oppose them.

Prof. Ferraris, of Turin, devised a motor in 1885 that united the fundamental ideas of two earlier experimenters, Walter Baily and Marcel Deprez. "Like Baily, he proposed to produce rotation of a copper conductor by means of eddy currents induced in it by a progressively shifted magnetic field; and this progressively shifted magnetic field he proposed to generate as a true rotatory field by combining at right angles to one another two alternate currents which differed by a quarter period from one another."* The driving force in the Hookham alternate current meter is obtained from a motor on the Ferraris principle—already used in supply meters for the same purpose by Ferranti, Wright, and Borel, and also by Shallenberger, Duncan, Schaeffer, and others. The field in which the brake disc revolves is produced, as in the continuous current meter, by a permanent magnet.

The out-of-phase currents are produced by taking advantage of the phase alteration in a circuit possessing large inductance, and coupled in shunt to the main circuit. The progressively shifted magnetic field is due to the mutual action of the main current to be metered flowing through two flat spiral coils, one of which is clearly shown in the accompanying figure, placed one above and the other below an aluminium disc; and a shunt current flowing through a coil wound on a laminated horse-shoe or circular electro-magnet. The main coils are placed to one side of the centre, but between the poles of the shunt electro-magnet, so that the driving disc is embraced both by the series coils and the shunt electro-magnet. As is well known, this device causes the currents in the series and main circuits to differ by a quarter period in phase, and, therefore, to cause eddy currents to be induced in the aluminium disc, which, reacting upon the inducing field, bring a torque into play and rotation of the disc ensues.

The braking force is also due to Foucault currents induced in the disc as it passes between the poles of an elongated ring permanent magnet. The disc thus acts both as the driving and braking disc, whereas in the continuous current meter these are separate. In the latter type the permanency of the magnetic field in which the brake disc revolves is ensured by a magnetic shunt;† in the alternate current meter a similar use is made of this device, but it is applied in a different manner. The method is, however, based on principles identical to those already described.

The section of the permanent magnet is reduced at a point just before its poles are reached, the reduction being about 88 per cent. The metal at the points where the reduction takes place is saturated, and by the increase in reluctance the flux between the poles is reduced. Outside the reduced sections a magnetic shunt is connected across the air-gap, so that the lines of induction divide equally between the shunt and the air-space. The result is, that the useful brake field is made permanent in value despite any changes, within reasonable limits, that may take place in the strength of the permanent magnet itself.

To assist the meter in starting, a small magnetic shield of copper sheet is placed between one pole of the shunt electro-magnet and the aluminium disc. The action is as follows:—The lines of induction produced by the electro-magnet set up Foucault currents in the copper shield, which itself screens a portion of the disc from the lines of induction. That part of the disc which is not screened has, however, induced currents set up in it, and these are in a similar sense to those in the copper plate. A constant attractive force is thereby produced between the copper plate and the disc, and this—as in Elihu Thomson's experiments—might of itself be sufficient to set and maintain the disc in continuous rotation. The action is so adjusted that the mutual attraction is *not* by itself powerful enough to do this unless the torque, due to a current in the series coil, is added to it.

Another corrective factor is applied to compensate for the additive or subtractive effect of the current in the main series coils on the induction in the shunt electro-magnet. As

* "Polyphase Electric Currents," S. P. Thompson, p. 88.

† M. M. C., figure on page 477.

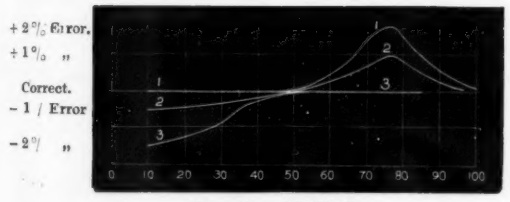
these meters are coupled up, the current in the series coils produces an increased induction in the shunt electro-magnet circuit, and, therefore, the driving force is augmented at the upper range of the meter to such an extent, that the increase may amount to nearly one-twentieth of the whole so operating. To compensate for the increased driving force, it is necessary to augment the brake force at the higher loads; that is, at the higher speeds of the driving disc. Air friction provides the means, and it is for this purpose that a fan is mounted on the vertical spindle below the disc. Whereas, in the Shallenberger meter, a fan of similar form provides the whole braking force; here it is used merely as a corrective factor. When the speed of the meter increases, the air-braking due to the fan rises faster than would be proportional to the speed, and does exactly what is wanted to maintain the revolutions per minute proportional to the current being integrated.

The curves which are shown below indicate what may be generally obtained in the performance of this meter, and it will be observed that the maximum divergence from correct reading is well within 2 per cent. for the range recorded in these tests.

In this meter we have the three corrections similar to those already noticed in the continuous current pattern. These are:—The magnetic screen, for bearing friction; the magnetic shunt, for change in flux; and the air-fan brake, for change in the induction through the shunt electro-magnet.

The most interesting patents relating to the Hookham meters are:—4,225, 1887; 17,502, 1887; 13,123, 1890; 40, 1891; 4,064, 1891; 14,239, 1892; 20,384, 1893.

In the fourth patent mentioned there are three things distinctly stated; that if contact be made at the edge of a disc by means of mercury,* so much mechanical resistance is set up that the disc will not start with small currents unless a very powerful field be employed, but this resistance is reduced by entirely immersing the disc in mercury. That the pole-pieces should be insulated from the mercury, and



Percentage of full load.

Alternate Current Meter Curves.

the rim and central portion of the disc should be amalgamated, so that when the disc is of copper and a relatively thin layer of mercury is used, the greater part of the current will flow through the disc, and only a small percentage through the mercury. That in order to obtain proportionality in the meter, the retardation due to the fluid friction of the mercury should be negligible compared with that due to eddy currents in the disc.

In the next patent a meter of the Teague or Perry type is referred to, and, specifically, the obtaining of constancy in the field of an electro-magnet by reducing the cross section of a pole-piece, and the combination with a motor-meter of fans moving in air or liquid, the resistance of such fans being relatively lessened as the speed *increases* in such a manner that the resistance approximately increases directly as the speed, are described. The second last patent enters into the detail, construction, and action of the continuous current meter already dealt with by us.

The third patent foreshadows the alternate current meter as we now know it. There is claimed, in meters for alternate or intermittent currents in which the rotation of a disc is produced by the reaction of currents induced in the disc the juxtaposition of a coil carrying the current to be measured, or a current proportional to it, and a coil constituting a shunt circuit in such a way that the field produced by the series coil lies partly under the poles of the shunt magnet.

* The Hartmann & Braun meter is of this type.

REVIEWS AND BOOK NOTICES.

A First Book of Electricity and Magnetism. By W. Perren Maycock. Second Edition. London: Whittaker & Co., Paternoster Square.

As a small elementary treatise this book is deserving of warm commendation, and is an advance on the first issue. The opening definition of "Magnetism," *i.e.*, "*anything* that has the power of attracting or picking up pieces of iron or steel," is, however, not a particularly scientific one, a stick with a piece of cobbler's wax at the end would pick up pieces of iron or steel, but it would hardly come under the definition of a magnet; however, we do not often come across such loose statements in the pages of the book. On page 72, a form of switch for coupling up cells in series or in parallel is described, the arrangement, though useful for lecture purposes (for which it was designed by the author), does not strike one as being a particularly brilliant idea, but, *apropos* of it, we would mention that about the year 1863 an interesting competition took place in the pages of the *Electrician* (the forerunner of the present journal of that name) with reference to switches for the purpose, when several good ideas were put forward. The arrangement suggested on page 91 of placing a semicircular piece of iron alongside a wire through which a current is flowing, in order to enhance the magnetic effect of a straight wire, appears to be novel and is good; in fact, all the experiments recommended are thoroughly practical and easily carried out. As a book for elementary teaching Mr. Maycock's production should prove most useful.

Journal of the Institution of Electrical Engineers, No. 118. London: E. and F. N. Spon, 125, Strand.

The general contents of this number are as follows: "A Magnetic Tester for Measuring Hysteresis in Sheet Iron," by Prof. Ewing, F.R.S.; "On the Recent Development of the Single-Acting High Speed Engine for Central Station Work," by Mark Robinson; "Zero-Torque Electricity Meter," by Joseph Edmondson; "Daily Insulation Testing of Telegraph Lines," by W. H. Preece.

University College, Bristol. Calendar for 1895—96.

This calendar contains the usual information common to publications of the kind.

CORRESPONDENCE.

Localisation of Submarine Cable Faults.

As the question of cable testing is being brought forward in your columns, I think the following method will perhaps be interesting:—

If, in the x arm of a Wheatstone bridge, we have an electromotive force, $\pm e$, then, in order to obtain a balance with equal ratios, we must make the value of the adjustable arm equal to $(x \pm r)$, where $\pm r$ represents what may be termed the "resistance equivalent" of the electromotive force, $\pm e$. As the galvanometer deflection is zero, the potential, E, at its terminals must be equal. The currents being the same in each of the four branches of the bridge, we get, from Kirchoff's laws,

$$E = c\,x \pm e;$$

$$\text{and } E = c\,(x \pm r).$$

Assuming (as is usually the case with cable faults) that e opposes the testing current, then

$$c\,x + e = c\,(x + r);$$

$$\therefore e = c\,r;$$

$$\text{or, } r = \frac{e}{c}.$$

If c be altered to c', while e remains constant, we get

$$r' = \frac{e}{c'};$$

$$\therefore r : r' :: \frac{e}{c} : \frac{e}{c'};$$

$$\text{or, } r : r' :: c' : c;$$

that is, *the apparent resistance due to the presence of a constant electromotive force in a circuit will be inversely proportional to the strength of current with which it is measured.*

From this it is easily proved that

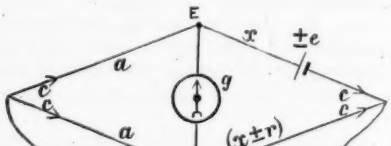
$$x = \frac{\text{A}\,c - \text{B}\,c'}{c - c'},$$

where A represents the bridge reading obtained with the current c, and B the balance produced with c'.

If necessary, a rough test can be rapidly made by reducing the E.M.F. of the testing battery to one-half its orignal strength for the second bridge reading, B, in which case

$$x = 2\,\text{A} - \text{B} \text{ (approximately).}$$

A small error in this test is due to the fact that the strength of the opposing electromotive force of polarisation at the fault decreases slightly with each reduction of the testing current. In a number of experiments (with the



object of eliminating this error), I obtained some very satisfactory results by taking several triple readings, d_1, d_2, and d_3, with various current strengths, and calculating in a manner similar to the following :—

Let r = the resistance due to e when measured with 25 milliampères. Then

(1) $x + r = d_1$ (measured with 25 milliampères).

(2) $x + 5r = d_2$ (measured with $\frac{25}{5}$ (or 5) milliampères).

(3) $x + 8r = d_3$ (measured with $\frac{25}{8}$ (or $3\frac{1}{8}$) milliampères).

From which

$$x = d_3 - 2\,(d_2 - d_1).$$

The *mean* value of x was taken from the figures thus obtained.

W. J. Medlyn.

Government Cable Station, Lowestoft.

Block Signalling.

I notice in an article under the above heading contained in your issue of October 4th, mention is made of the employment of "insulated track rails" for the purpose of block signalling in America.

The principle is, as you state, well known in this country, and has been tried by most railway electrical engineers, who, like myself, have devoted upwards of a quarter of a century to the application of electricity to railway purposes, and there is little doubt that of all the numerous devices, treadles, &c., which have from time to time been introduced, there are none which meet the requirements so thoroughly as the insulated track.

The difficulty you mention, that of insulating the points and crossings may, to a certain extent, militate against its adoption. But there is another which I do not remember ever having seen noticed in print, which seems rather serious, namely, the fact of nearly all the passenger carriage wheels in England being constructed of wood; the steel tyres are *insulated from the axles*, and therefore fail to short-circuit the rails, so that in the case of a break away, or a carriage being left on the rails by any means, without an engine attached, *no signal* would be given, and unless all the railway companies can be persuaded to alter the construction of their carriage wheels, the insulated track system, excellent though it may be, will have little chance of being adopted universally.

It may be argued that it is a simple matter to connect the tyre electrically with the hub of the wheel. So it is. But to connect tens of thousands of these wheels would involve such a serious outlay, that unless perfect immunity from failure could be guaranteed, few of the railway companies would feel justified in incurring the expense.

None of these difficulties are, however, insurmountable, and there is no doubt when the directors of the various railway companies see the necessity for making an alteration they will be able to find plenty of their own staff who are quite capable of suggesting and carrying out any improvements that may be deemed advisable in a far more satisfactory manner than any outsiders, knowing as they do the requirements of the traffic at each place.

What is really required is the adaptation of appliances already known to the existing state of things, not the introduction of new systems.

F. W. Cooke, M.I.E.E.

G. N. Ry., Retford,
October 15*th*, 1895.

Like your correspondent, "Zeto," I should like to know the method of insulating the rails from the earth adopted in America. I believe the track is divided into sections varying from 1,000 to 2,000 yards in length, and that there has been no case of a break down in the insulation. Another important point is that the rails of each section should be in electrical continuity with each other, and this quite independently of the fish plates, which are always more or less covered with rust. This difficulty of obtaining perfect electrical continuity was overcome years ago by "bonding," and the Chicago bond is, no doubt, one of the best of its kind.

As your correspondent is, no doubt, connected with railways, and has opportunities of trying experiments, I may say that if he writes to me I shall be happy to suggest a method of insulating the rails, which I believe will be found, on experiment, to be practically proof against rain.

Geo. C. Purvis, B.Sc., &c.

October 19*th*, 1895.

The Horseless Carriages Exhibition.

Will you allow me to make a slight correction anent your report of above. Although in England, and although mentioned in the programme of the exhibition, the petroleum tricycle to have been exhibited by M. Guédon for the Gladiator Cycle Company, of France, did not put in an appearance at all.

Two interesting exhibits, which you do not allude to, were a cycle hansom and a cycle carriage, both driven by two men, fore and aft, and made by Messrs. Wartmann & Co., 72 & 73, Cowcross Street, E.C. These vehicles, to seat one and two persons respectively, certainly got over the rough ground as well as the engine-driven exhibits, and would possibly have attracted more attention had they been cleaned up a little after their journey from London.

W. Perren Maycock.

Croydon, *October* 18*th*, 1895.

Electric Lighting in Spain.

Referring to the correspondence on this subject in your pages, I should like to point out that there have been several cases where municipal bodies in Spain have invited tenders for the concession for the electric lighting of the town, with the result "desierta," that is, no tenders submitted in response, the same bodies at a later date re-issuing the notice for tenders. To give an example, according to an official announcement, not a single tender has been submitted for the concession for the electric lighting of the town of Almodovar del Campo. It would be interesting to learn from your Spanish correspondents whether we are to accept this information literally, or whether it is only a "blind," and that the concession has already been taken up.

Chas. J. Webb.

The Choice of Transformers.

Referring to Mr. Adams's reply in your issue of October 18th, to my previous letter, the transformer I instanced was the ordinary commercial article manufactured by the firm alluded to by me, and not specially made for testing purposes.

I am unable to oblige Mr. Adams with particulars of the construction, but I can inform him that the loss in the copper on the transformer I referred to is 27 watts, and the drop in volts from no load to full load is $2\frac{3}{4}$ per cent.

With regard to the alteration of the transforming ratio: Mr. Adams leaves the primary turns and section of iron constant; he must double his secondary turns, which he will find impossible to do in a well designed transformer, as there is no room for them without extending the ironwork, and consequently increasing the weight of iron and the watts lost in it. Besides, supposing that the double secondary can be got on; then, you have increased the cost of your transformer by this extra copper, and also increased your voltage drop and copper loss by about 50 per cent. each.

High primary voltage does not mean a bad transformer; that is caused by bad design.

S. R. C.

Paralleling of Compound Dynamos.

I must thank you and your correspondent for the interesting letter in answer to mine on "The Paralleling of Compound Dynamos," which appears in your issue of October 18th. Your correspondent says it is necessary for equal division of load to have the resistances of the cable connections of the two dynamos equal, besides those of the armatures and series windings. In my case one dynamo is almost 6 feet further away from the switchboard than the other, so that the cable connections are not equal in resistance. This, I understood from the makers, would not be sufficient to cause the trouble, but I may probably find that it is so. Again thanking you for the required information.

O. V. G.

October 20th, 1895.

Unwarrantable Competition in Electrical Wiring.

It is, I admit, with some misgiving that I beg permission to hint through your valuable medium at a suggestion of a step in the direction of mitigating this ever growing evil. Quite aware am I that I court unfavourable criticism from many of your readers, but I trust that they, as well as the members of our valuable Institution of Electrical Engineers, will be charitable enough to give me the credit for having written these lines in what is, in my opinion, the interest of the profession to which I belong.

In so doing I hope that they will display their good will by giving us the benefit of their views, for if among us we are able in the near future to arrive at some practical means of preventing, even in a measure, this—to use a vulgar but expressive term, "throat-cutting"—I shall not even regret any derision this letter may occasion. Thus my proposition for what it is worth.

I would respectfully suggest that our Institution should endeavour to deal with this question, and I would therefore propose that a committee should be appointed for that purpose. Such committee to be composed of a certain number of contractors as well as consulting engineers. That the committee be requested by the Institution to endeavour to study and report upon the "causes" and "effects" of the extraordinary discrepancies that so constantly appear in the figures of the various tenders accepted and rejected, more particularly in that branch known as "wiring work."

If our Institution would lend its moral support to such a movement at the present juncture, I venture to think that, having once attacked the disease at its root, a remedy might be discovered, and I will even go as far as to say that though I consider it premature to broach so complex a subject just now, I do not think that the cure would prove so intractable as we are apparently inclined to believe. In any case, if you will be good enough to give publication to this letter, possibly it will induce some expression of opinion from others, which, to my mind, will be a step in the right direction.

Further comment from me for the moment would, I venture to believe, be superfluous, but, in concluding, let me add that having carefully thought this matter out I shall anxiously scan your forthcoming issues with the hope that I may be encouraged to express my further views.

Arthur Bergtheil, M.Inst.E.E.

October 22nd, 1895.

EFFICIENCY TESTS OF ENGINEERING APPLIANCES.

The *Technological Quarterly* recently published some results of tests made with various engineering appliances not usually subjected to special testing, but which have a certain interest in that they afford information upon points very little studied. We may know what an injector will do, for example, but we do not know so well how much steam it will consume in doing its work. As a rule, perhaps, we do not care much how great is its consumption of steam, for if used as a boiler feeder, all the steam used gets back into the boiler, and there is no consumption of heat except that due to performance of work in forcing the feed-water against the boiler pressure. Any excess of velocity of the water is recovered as heat by eddies and friction in the boiler.

The instruments tested were a Hancock ejector, a pulsometer, a duplex Blake pump, a belt machine, flow of steam, a Mack injector, a Hancock inspirator, a Wheeler condenser, boilers, and a Douglas hydraulic ram, and in what follows we have endeavoured to extract the pith of the information afforded.

The Hancock ejector was a No. 6 size, with $\frac{3}{8}$ths inch steam orifice and 2 inches delivery pipe. The lift was variable, and so was the resistance in the delivery pipe. The steam used was calculated from its known flow through an orifice, and the water over a weir, or by weighing.

The duty is given in foot-pounds per million thermal units, and the heat used, is given as the total heat of the steam, less the heat of the liquid at the delivery. The tests were made at the Massachusetts Institute of Technology, and were 48 in number. The duty varied from as low as 375,000 foot-pounds per million units to as high as 1,258,000 foot-pounds, and usually the better duties accompanied higher pressures of steam and higher total lift of water. The highest efficiency is ·16 per cent., and the lowest about ·04, these efficiencies being calculated simply on the duty done per unit of heat disappearing, and without reference to the thermo-dynamic maximum possible efficiency as calculable from the limits of temperature of the working fluid. But even with this allowance the instrument, as a machine, is not, under the conditions, particularly efficient. Probably the maximum possible efficiency might be as low as 12 per cent. Being only about ·12 per cent., the true efficiency thermo-dynamically is but 1 per cent. The results, however, are not inclusive of the final temperature of discharge, so that this figure can only be approximate. It is sufficient to show that the ejector is more useful as a heater than as a pump, but ejectors can very usefully be applied to raise water from deep wells where such water will, before long, be used for boiler feeding purposes, and the heat will be recoverable.

The pulsometer tests were made with a No. 4 pulsometer. Water was drawn from a tank 8 feet below the pump, and the delivery pressure was variable by means of a throttle, and measured over a weir. The pulses were counted.

The best results seem to attend a steam pressure of about 50 lbs., and a resistance of about 60 feet. These data produced an efficiency of ·69 per cent., and generally the efficiency was from double to sixfold that of the ejector; but efficiency did not increase with the higher pressures beyond about 50 lbs. The efficiency in the pulsometer seems to be dependent upon work done, the best efficiency accompanying the highest duty, irrespective of pressure of steam, and also of the temperature of the suction. The pulsometer, on the whole, suffers less from variation of steam pressure than does an injector, and it should be fairly well pushed to render it most efficient.

The duplex pump tests were made on a 16-inch, $10\frac{1}{2}$-inch by 12-inch pump lifting about 8 feet in height through 15 feet of 8-inch pipe and discharging to a 7-inch pipe. There

was no air chamber on the suction pipe but simply an opening $\frac{1}{8}$-inch diameter to prevent pounding. The water discharged was measured both by calculation of flow through a nozzle and at a weir. The pump proved itself more efficient than the pulsometer, the greatest efficiency of which was ·82 per cent., whereas the pump showed from 86 to 93, and there was very little difference in efficiency between tests at widely different duties. Apparently the duplex pump is a steady going machine, the above efficiencies being mechanical, not thermal, and no such variation in efficiency is to be found as characterises the injector and the pulsometer; but at best even the duplex pump has but a poor record, and where used as a boiler feed-pump it is not a little surprising to see it forcing cold water at 52° from a well and discharging its exhaust steam into the atmosphere instead of through a coil in the cold delivery pipe whereby if properly arranged the actual commercial efficiency of the pump would be much improved. Frequently, too, where coldness is not essential this would reduce the sweating of pipes and tend to their preservation. The steam used per horse-power hour varied from 66 pounds when doing 28 million foot pounds per million B.T.U., to 145 pounds at 12 million foot pounds duty, the mechanical efficiency also being higher at the higher duty. The highest duty of the pulsometer was nearly 6½ million, so that the pump was the better implement, though in the pulsometer in cases where heat is needed in the water there is, of course, no loss.

Flow of Steam.

In these tests steam was passed through an orifice 2½ inches long and ¼-inch diameter, the entrance being rounded to ¼-inch radius. The steam was condensed on cold surfaces and weighed. The apparatus formed its own throttling calorimeter whereby the quality of the inflow was obtained by measurement of the superheat and the pressure in the orifice was taken by means of a hole $\frac{1}{64}$th-inch drilled at right angles.

The boiler pressure only varied from about 108 to 112 pounds on the gauge. The back pressure was varied from 3·6 to 106·1 pounds. For the first the pressure in the orifice was 62·8 pounds, and for the second 105·9, the boiler pressures being 108·9 and 111·9, and no matter how low the back pressure, that in the orifice never fell below 62·8, or practically $\frac{5}{9}$ths of the boiler pressure when both are reckoned at their absolute, not at their gauge readings, just as found by the committee on safety valves some years ago which determined the rate at which steam would flow into different external pressures. Up to 50 lbs. gauge pressure the orifice pressure was maintained almost constant, above that pressure a steady rise in the orifice pressure is noted.

Belt Machine.

For the testing of belts a machine was contrived in which the tensions could be measured both tight and slack side, or T_1, T_2, and $T_1 + T_2$. The belts used were leather laced double belts 7 inches wide, and, we presume, the belt also was leather, but this is not stated. The tests were made to determine slip, and this varied between 2·4 per cent. for 6·15 horse-power to 29·4 per cent. for 16·97 horse-power, but only 6·4 per cent. is recorded for 16·43 horse-power. As between the horse powers 16·97 and 16·43, however, the ratio $\frac{T_1}{T_2}$ was 2·593 and 2·097, which seems to show that where a third of the total pull of a belt is upon the slack side the slip will be moderate, but that any smaller ratio of slack side tension is insufficient and will lead to slip. The pulleys were 30 inches diameter. The coefficient of friction seems, therefore, to be properly taken at about ·25, excessive slip occurring at ·31 without material increase of power transmitted to explain this otherwise.

Similar tests with 4-inch single belts show only 11 per cent. of slip, even up to a frictional coefficient of ·49 and a ratio of $\frac{T_1}{T_2} = 4{\cdot}5$, and even 5·1, which appears to indicate the better grip of single belts, and, possibly, also of narrower belts, even when the horse-power transmitted was 10, a higher relative figure than the 18 horse-power of the 7-inch double belt. The minimum slip was practically the same as in the previous tests, viz., 2·3 per cent. for a ratio of tensions, also about the same, or 1·37 in place of 1·318, and frictional coefficient ·10 in place of ·09.

For reasonable practice at a speed of 1,500 feet per minute a 4-inch belt may be strained to about 220 lbs. on its tight side, or to a total of 360 lbs. on both sides, leaving 220 lbs. slack side tension, and it should then not slip more than 3 to 5 per cent. and should transmit 4 to 5 H.P. In such a case the total tension per horse-power will run about 80 lbs. also, or $T_1 + T_2 = 80$ lbs. per H.P.

PEACHE'S PATENT HIGH SPEED SINGLE-ACTING ENGINE.

On Wednesday evening last, Mr. James Paxman gave a reception to a large number of eminent engineers. The gathering took place in the electric light shed of the Empire of India Exhibition, Earl's Court, and, apart from the social side of the reception, it gave an opportunity of exhibiting to those present some examples of Peache's patent high-speed compound engines, which Messrs. Davey, Paxman and Co. are now putting on the market.

Space will not allow us to dwell upon the details of the meeting, which was quite a notable one; suffice it to say that the arrangements for the comfort and amusement of the guests were carried out in a most admirable manner, and Mr. Paxman must have derived no little satisfaction from the real interest taken in the new engine, and the evident signs of pleasure evinced on every side.

A contract for the supply of power to the installation of the India Exhibition was at the end of last year awarded by the London Exhibitions Company to Messrs. Davey, Paxman & Co, of Colchester.

The lighting of the grounds, and of the various buildings comprised in the Empire of India Exhibition, which was arranged by, and is under the charge of, Mr. Guy C. Fricker, has already been described and illustrated in previous issues, and, seeing that the installation is for a number of years, it has assumed quite the character of a small "central station." The exigencies of the case, however, call for two systems of driving, so that a part of the station is devoted to a belt-driven plant, and part to direct coupled high speed engine plant. Altogether, there are eight belt-driven dynamos, all of the Brush Electrical Engineering Company's manufacture, but of various descriptions, viz.:—

One 75-kilowatt Mordey alternator.
Five 55-light Brush arc machines.
One 40-kilowatt low tension machine.
One 20-kilowatt " "

These are driven by two compound engines of Messrs. Davey, Paxman & Co.'s well-known "Colchester" type, capable of developing 250 and 120 H.P. respectively, and one of their compound coupled girder engines capable of developing 120 H.P. All these engines are fitted with Paxman's patent automatic expansion gear. This plant is evidently doing excellent work. The engines, however, are so well known, that no detailed description of them is necessary.

The chief interest centres in the high speed single-acting engines, made under the patents of Mr. Peache, which are a new departure in Messrs. Davey, Paxman & Co.'s practice. Two of them are three-crank engines, with three sets of compound cylinders 10 inches diameter and 15 inches diameter × 10 inches stroke, arranged tandem over each crank. Each engine is coupled direct to a 100-kilowatt Mordey alternator, and runs at 325 revolutions per minute, developing about 220 H.P. each.

The third is an engine with cylinders of the same size, but with two cranks only, set at an angle of 180°, coupled direct to a 75-kilowatt Mordey alternator, running at 355 revolutions per minute, and developing about 150 H.P.

The engines run very silently, and there is no vibration perceptible. The governing is very close, being within 2 per cent. from full to no load, and yet there is no unsteadiness or tendency to "hunt." This is especially noticeable in the two-crank engine coupled to the 75-kilowatt alternator, which supplies the Empress Theatre lighting. In the exigencies of the theatre lighting, 80 to 100 H.P. is during the evening thrown off and on, often being nearly the whole load on the engine at the time, but the governor handles this with the greatest promptness, and without any perceptible change in the speed of the engine.

The plant has been put down without allowance for spares, and during the evening all the engines are loaded, the confidence thus displayed by the Exhibition Authorities in their contractors, Messrs. Davey, Paxman & Co., being justified, for there has been no failure or hitch with the running of any of the engines.

The three "Peache" engines are, with the exception of the experimental engine which was started in January of this year, the first that have been made, and it speaks well for the excellence both of their design and their manufacture, that they should have borne the above responsibility so successfully.

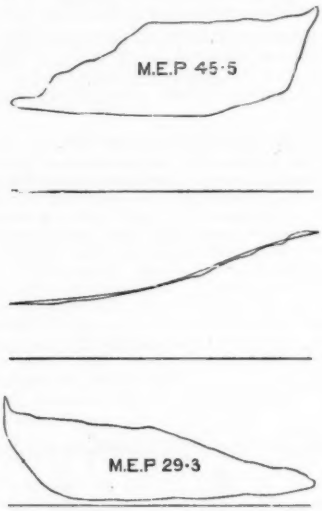
In the early days of electric lighting the names of Davey, Paxman and Co. figured in most installations; but in late years other firms, especially that of Willans and Robinson, have come to the front with high speed engines. From what we saw last night, and judging from the frankly expressed opinions of men most competent to form correct impressions, there seems every probability that, in the hands of the eminent Colchester engineers, Peache's engine will be a formidable rival to the best of its class.

Referring to the sectional view given, it will be seen that the high and low pressure cylinders are arranged tandem over the crankshaft.

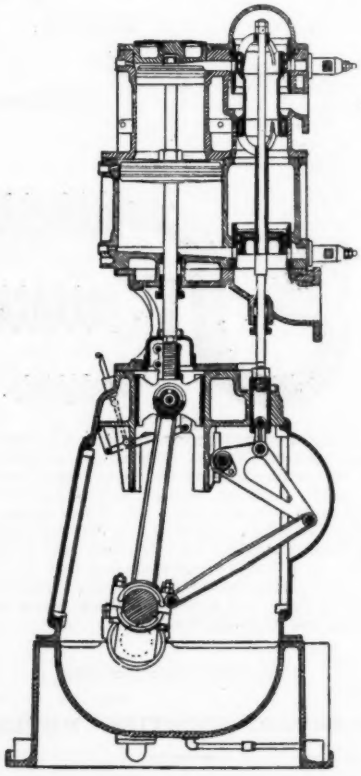
The crankshaft, instead of being placed in line with the cylinders as usual, is placed out of line to the extent of the throw of the cranks. In a single-acting engine this is the right position for the crankshaft, for the crosshead slide is thus rendered single acting, and moreover the pressure on it is relieved, for during the down stroke, when the pressures are heaviest, the connecting rod is straight, or inclined at a small angle, while on the up stroke, when the angle of the connecting rod is considerable, the pressures passing through the crosshead

DIAGRAMS TAKEN FROM PEACHE'S PATENT HIGH SPEED ENGINE.

Cylinders 10″ and 15″ diameter × 10½ stroke.



I.H.P. 81·3. Water per I.H.P. per hour 22 lbs.
Boiler pressure 130 lbs. M.E.P. reduced to L.P. piston 49·8 lbs.



are at a minimum. In addition to the above reasons for justifying the unusual position of the crankshaft, in the present case it is claimed that it enables a very simple form of valve gear to be adopted, doing away with eccentrics, and thus giving room for large and compact bearings.

The distribution of steam in the engine is effected by a line of piston valves. Steam is admitted under the high pressure valve to the top of the high pressure piston, thence it is exhausted over the top of the high pressure valve, and through the centre of that valve to the receiver space. From there it is admitted over the top of the low pressure valve to the underside of the low pressure piston, and finally under the low pressure valve to the exhaust. The holding down of the line of pistons on the up stroke is effected by the compression of steam in the space between the high pressure and the low pressure cylinders, called the controlling cylinder; this steam is again expanded on the down stroke. A very small bye-pass port is provided, which is uncovered by the high pressure piston at the top of its stroke, and which for an instant forms a communication between the top and the bottom of the high pressure piston. The makers claim that this provides for the supply of any fresh steam which may be needed to maintain the supply of steam in the controlling cylinder, and here attention must be called to an important feature in the provision of the holding down power, and one which is peculiar to this engine. The controlling cylinder diagram can be arranged so that it expands below the pressure of the steam in the low pressure cylinder, and consequently on the first half of the upstroke, instead of the inertia of the reciprocating parts having to be overcome by power transmitted through the crankshaft, as is the case in other single-acting engines; it is overcome by the excess power developed on the underside of the low pressure piston. The effect on strains in the crankshaft, and friction on bearings, is apparent.

It may be said that steam being used in the controlling cylinder must mean loss from condensation, but the position of the controlling cylinder in this engine must be remembered, viz., between the high pressure and low pressure cylinders, and it is contended with reason that any heat passing from the steam in this cylinder does good work in heating up the walls for the following steam stroke in the high pressure and low pressure cylinders, and, in fact, with superheated steam or with superheating coils in the controlling cylinder, it is contemplated that the controlling cylinder may become the most efficient "steam jacket" possible, viz., one that heats up the working surfaces in the working cylinders. The valves are shown arranged to be held down by the receiver pressure steam, and usually this is satisfactory, but in cases that require it, a modification of the controlling cylinder can be applied.

The diagrams are reproduced from one set of a number taken from the first engine built, during a six hours steam trial at Colchester on July 26th, 1895. The engine was run on the brake, and gave a consumption of 22 lbs. of steam per indicated horse-power—88 per cent. of the indicated horse-power being measured on the brake. The boiler pressure available was 130 lbs., there were sundry small leaks, and the steam was taken direct from the boiler to the engine without a separator being interposed, so that no doubt the engine did not get all the feed water that was debited to it as steam. The engine, too, was arranged as it would be in practice, viz., with a cut-off sufficiently late to give high M.E.P. (49·8 lbs. in this case, with 130 lbs. boiler pressure, and not with a comparatively early cut-off so as to give a specially low steam consumption per indicated horse-power. These diagrams have been reproduced, therefore, not as a measure of the efficiency of the engine, but to give an idea of its working. Messrs. Davey, Paxman & Co. have no hesitation in saying that with the few slight alterations which the results obtained from these first engines have suggested, the "Peache" engine will give an economy that will compare favourably with any high-class engine now being built.

Special attention has been given to sound mechanical construction. The crankshaft, as it should be in a single-acting engine, has been made of ample strength, viz., one-third the diameter of the low pressure cylinder. All bearings are very ample, and all parts are simple and strong. Consequently the engine will stand readily any pressure that can be brought to bear on it, whether for short or long runs. Every part is as easily accessible for examination or removal as in an ordinary double-acting engine. There are no internal glands, and of the two external glands, one is exposed to the steam in the low-pressure cylinder only, and the other to exhaust pressure steam only.

Governing is by throttle valve, and can be by a powerful sensitive spring governor, as at the exhibition, in which the variation in speed between full and no load does not exceed 2 per cent.; or a governor with a hand speed adjustment of 25 per cent. to 30 per cent. can be fitted, and which will work to within a variation of 2½ per cent. between full load and no load throughout its full range of adjustment.

The advantages of the three-crank type of engine are so great, both on account of absence of vibration and evenness of turning, that Messrs. Davey, Paxman & Co. have adopted that as their standard type of engine. An illustration of the engine appears in our Notes columns.

BUSINESS NOTICES, &c.

Compensation for Injuries by Shock.—In the Bloomsbury County Court, on Thursday, before his Honour Judge Bacon, the case of Arnold *v.* Harrod's Stores was tried. The claim was brought under the Employers' Liability Act by an electric wireman for damages for personal injuries. Plaintiff's case was that in July he was at work in the new building at Brompton, and as soon as he commenced work he was burnt by an electric shock from a live wire. A piece was taken off the pliers, and his hand was so hurt that for nearly five weeks he was unable to work. His wages were about £2 2s. a week. His contention was that the engineer, Mr. Peters, should have told him the wires were "alive," and that the ends ought to have been taped. Mr. Wakeley, for the defendants, called Mr. Peters, A.I.E.E. Mr. Bate, of the National Electrical Engineering Company, and others, gave evidence that workmen ascertained whether the wires were "alive" or not, and that it was not the custom to tape the ends of unfinished work. In the end his Honour found for the plaintiff for £10 and costs.

Bankruptcy Proceedings.—At the London Bankruptcy Court, on Wednesday, Mary Ann Hillock, who traded at 146, Southampton Row, W.C., as the Medical Electrode Company, was allowed to pass her public examination upon accounts showing liabilities £1,521 6s. 2d., and assets *nil*.

Dissolutions of Partnerships.—Messrs. J. Patchett, F. Patchett and R. Patchett, hitherto trading as card cloth manufacturers and manufacturers of wires for electric purposes, under the style of Patchett Bros. and the Northern Electric Wire Company, at Sedburgh Mills, Halifax, York, have dissolved partnership from 15th inst., so far as concerns J. Patchett. The other two partners will carry on the businesses, and attend to the debts of and by the late firm.

Messrs. T. M. Heywood and P. R Fergus, hitherto trading as electricians at Mount Stuart Square, Cardiff, under the style of Fergus and Co., have dissolved partnership by mutual consent as and from October 7th. T. M. Heywood will attend to the late firm's debts.

Changes of Address.—Mr. T. Harding Churton has removed his works and stores at Leeds from Park Cross Street to much larger and more convenient premises at 36, Great Wilson Street. The works are suitably equipped for the manufacture of electrical plant, and are now busily engaged, Mr. Churton having on hand several large contracts for lighting and transmission of power plant. We are desired to state that all communications should be addressed to the offices at 5, South Parade, and goods to the stores at 36, Great Wilson Street.

The lease of the present works of the Consolidated Telephone Construction and Manufacturing Company, Limited, expiring with the current year, this company has recently purchased the freehold of the Overstone Works, at Coventry, and a large area of ground attached thereto, giving plenty of room for extension of business. The offices, &c., will remain in London, due notification being given of the location. The principals and most of the staff are retained.

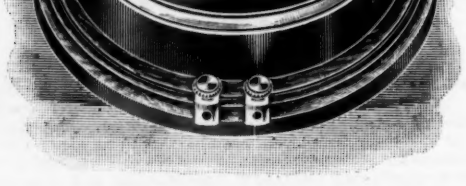
Electrical Fittings Manufacture.—According to the *Bedford Times* some property has recently been purchased in Woburn Road, Kempston, and let to the Crystal Electric Lamp Company for the manufacture of fittings for electric lamps. It is stated that over 150 persons will be employed at the works.

Personal.—We are requested by Earl Russell to announce that, in consequence of the pressure on his time caused by the work of the London County Council, he has been compelled to relinquish his business as electrical contractor, carried on under the style of Russell & Co., at 11, Queen Victoria Street, E C.

Price Lists.—Messrs. M. E. Austin & Co., of Armley, have sent us a very neatly-prepared circular of their "Infant" improved dynamometer, which we described in our last issue.

An illustrated price list of Wenham gas lamps, governors, and ventilators, has been sent to us by the Lighting Corporation, Limited, of Bloomsbury, Street, W.C.

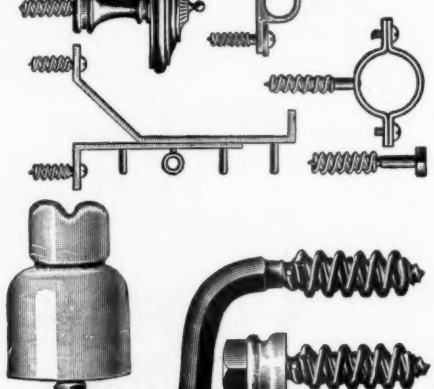
Small Regulating Transformers and Choking Coils.—Messrs. Miller & Woods are making a speciality of the manufacture of all kinds of small transformers and choking coils. By means of the regulating transformers (L. Miller's patent), which are said to be quite new, any desired voltage can be obtained by connecting the primary winding to street mains fed with alternating current. By turning the knob, the voltage at the secondary terminals can be varied between 0-200, 0-100, 0-50, or any other range, according to the scale of the instrument best suited to give the volts and ampères required. The alteration is effected by graduations of about ½ volt in the wide



range instrument, and correspondingly less in the others. The transformers are stocked in two sizes—150 watts and 250 watts capacity. Their regulating choking coil can be mounted in place of an ordinary electric light switch, and the current through the lamp connected to it diminished gradually, by turning the knob, till the lamp filament is only a dull red. It can also be used for many other purposes where a convenient means of regulating an alternating current is desired. The effect of turning round the knob is to cut out windings round a ring core, one by one, without causing any breaks or jumps in the current, and without finally leaving the resistance of the wire itself in the circuit, as when a movable core is used. A modification of this apparatus is made in the form of a table lamp, with a vertical fluted stem instead of the knob. The stem can be turned round relatively to the base, and the light of a lamp at the top of it raised or lowered as desired. The firm find there is a real want of an arrangement for turning down the last light left on in bedrooms of many houses, and, where the supply is alternating, their small switch-choking coil fixed, if possible, within reach of the bed, is very suitable. In the case of an 8 C.P. 100-volt lamp, the current is reduced to a half, and the light to about $\frac{1}{10}$th. The cost to the consumer is, therefore, only half that of an 8-C.P. lamp, even when current meters, and not wattmeters, are employed. A point claimed in favour of this apparatus is the fact that the light is reduced by imperceptible graduations, without any dark intervals.

Theatre Fittings.—We are informed that Mr. George Alexander has placed with Messrs. S. Dixon & Son the order for electrical fittings for St. James's Theatre, London. They will be similar to those supplied by the same firm for the Leeds Grand Theatre.

Wire Wall Plugs for Screws.—Mr. F. W. Ostermann, of 27, Leadenhall Street, E.C., is introducing into this country a very useful invention, to take the place of the wooden plugs generally used when it is desired to screw into brick or plaster walls. As will be seen from the illustrations, the device is simply a spiral of iron wire doubled back upon itself, the inner turns being of such a diameter as to form a kind of female screw thread, while the outer turns serve to hold the "wire plug" in the wall. The method of fixing these "Acme Plugs" is as follows:—A hole is drilled in the wall ¼ inch greater in diameter than the outside dimensions of the plug, and a little deeper than the length of the latter. The hole is then thoroughly wetted by injecting water from a small syringe, and afterwards filled with plaster of Paris. The outer windings of the wire socket are also filled with plaster, and the socket or plug with its screw is inserted in the hole to the required depth. After the



plaster has set, the screw may be removed, and it is as well to grease it before finally screwing it back. This device is likely to be found of great use by electrical fitters for fixing switchboards, switches, pushes, and other electrical fittings, as well as by decorators, plumbers, &c.; more especially when the fitting has to be done in occupied houses. To meet the latter case, a very complete and simple set of tools is supplied, as follows:—(1), Two sets of drills for hard and soft walls; (2), a trough to catch the dust from the drill; (3), a set of zinc plates for protecting the wall paper against water and plaster; (4), a syringe; (5), a set of half-cut tubes for inserting plaster; and (6), a set of small towels.

ELECTRIC LIGHTING NOTES.

Aberystwyth.—The Council is paying the sum of £21 to Mr. Preece for professional services in connection with electric lighting. More arc lamps are to be purchased and erected.

Adelaide.—The Corporation recently discussed the question of street lighting, and has accepted the offer of Messrs. Thompson & Co. to erect, and provide current for, a 2,000-C.P. arc lamp in King William Street at a stated charge.

Alderley Edge.—The District Council is entering into an agreement with Mr. Clirehugh, electrical engineer, for the transference of the provisional order which they recently procured at a cost of £320.

Bangor.—The Town Commissioners have had another discussion regarding the electric lighting question, but do not seem at all in a hurry to come to a decision. Further inquiries are being made.

Bexhill.—Notice having been served on the Council that Lord Cantelupe and another intend applying for an electric lighting provisional order, the matter has been referred to a committee.

Brandon and Byshottles.—The District Council has decided to light the three wards of its district by electricity.

Calcutta.—There appears at present to be an inclination on the part of the Calcutta Commissioners to seriously consider the electric lighting question. A special committee has been engaged upon the subject for some time, and has now recommended that tenders be invited for lighting Harrison Road. *Indian Engineering*, discussing the affair in a leading article, recommends that the likelihood of the repetition of past failures should be guarded against by the introduction of none but the best obtainable plant, and the employment of first-class practicians of long experience to carry out the work of erection. Our contemporary attaches great importance to the selection of a reliable system of distribution, strongly deprecates the proposal to use overhead wires for lighting purposes along the crowded thoroughfares of Calcutta City, and recommends that great attention be given to, and allowance made for, an extensive use of current for motive power purposes.

Coventry.—We understand that owing to a slight accident, the turning on the electric current, which was to take place next week, will be delayed.

Devonport.—Two companies having given notice of their intention to apply for electric lighting provisional orders, the Borough Council has considered the matter, and has passed a resolution expressing the opinion that the powers should be retained by the Council. The Electric Lighting Committee have power to apply for a provisional order, should they think it desirable after further consideration.

Exeter.—A committee of the City Council has been appointed to confer with the electric light company on any question of repairs or the renewal of any plant in the purchase of the undertaking.

Folkestone.—On Wednesday last week the Corporation made an order for payment of Mr. Medhurst's account for services rendered to the Electric Lighting Committee, despite a lengthy protest from Councillor Thompson.

Fulham.—Six consulting electrical engineers are to go before the Electric Lighting Committee for them to select one to report upon the electric lighting of the district, at a fee of £50. The Vestry is opposing the application being made for a provisional order by the Capital and Counties Electricity Supply Company.

Glasgow.—A Committee of the Police Commission is considering the question of electrically lighting the city, with special reference to the kind of lamp to be used.

Hampstead.—According to a statement made at last week's Vestry meeting, there are now 17,000 8-C.P. lamps connected to the mains.

A main for private lighting is to be laid down in Boundary Road, at a cost of £156. The Vestry has expressed itself willing to light the High Road, Kilburn, with 24 arc lamps in the middle of the road, lamps, connections and work to cost £1,009, and £29 13s. 6d. per lamp per annum for cost of running, provided the Willesden District Council pays half the cost of the installation and half the yearly cost.

Hanley.—On 16th inst. there was a Local Government Board inquiry into the Council's application for borrowing £20,000 for extending the electric light works and mains. The Town Clerk submitted a statement and figures showing the present position of electrical matters at Hanley.

Heaton Norriss.—The question of the Parish Council applying for a provisional electric lighting order is under consideration.

Islington.—At the last meeting of the Vestry, consideration of the question of the extra £25,000 necessary to complete the electric lighting undertaking was resumed. After several speakers had taken up the time of the Vestry, Mr. Gay, the electrical engineer, was asked to make a statement. His remarks were mainly directed to contradiction of statements made by a vestryman at the previous meeting, and showing that the extra expenditure was really necessary. After Mr. Gay's statement, the extra money was voted.

Italy.—A central station has recently been completed and put in operation at Lovere. Water power is utilised, the plant comprising two 60-H.P. turbines and two Siemens & Halske dynamos.

Kingstown.—The Town Commissioners on 21st inst. passed a resolution in favour of obtaining an electric lighting provisional order. A committee is to arrange the details of the application.

Llandrindod Wells.—A Birmingham firm is to be represented at a special meeting of the District Council to be held shortly to explain its proposals regarding electric or gas lighting for the town.

London.—The surveyor of the St. George's (Hanover Square) Vestry is considering the electric lighting question.

Mersey Docks.—The electric light is to be supplied for lighting the Prince's landing stage for the convenience of trans-Atlantic steamers after dark. Similar lights are also to be placed at each side of the Canada Dock, and one between the Canada and Huskisson Docks, for the Mersey Docks and Harbour Board.

Newcastle.—There is a rumpus on at Newcastle just now, the Gas Company and the City Lighting Committee being at loggerheads. The gas folks are, according to the *Newcastle Leader*, up in arms against the further use of electric lamps, and the Lighting Committee favours electricity, and is using it in certain thoroughfares instead of gas, whereas the Gas Company, considering the Committee is acting beyond its rights, are keeping the gas lamps alight, so that there are both kinds of lighting in the same streets. This seems a somewhat similar squabble to that which has been carried on at Killarney for the past year, and is not yet ended. The Lighting Committee of the Newcastle Council are considering the matter, and it is hoped there will be a speedy settlement by the Gas Company being brought to its senses, if the Council are acting within the terms of their contract.

Plymouth.—Mr. John Harris, of Stonehouse, Devon, has just completed extensive additions to the electric lighting plant which was laid down by him 12 months ago at the engineering works of Messrs. Bickle & Co., in the Great Western Docks, Plymouth. The new plant was necessitated by an extension of the works.

Rangoon.—Regarding the tenders which have been invited for some time past for the electric lighting of Rangoon, we learn from an Indian exchange that several tenders from the leading electrical firms, both in England and Germany, are already to hand, and representatives on the spot. It is expected that the competition will be severe, and the tenders of none but well-established and known firms will be considered.

South Molton.—The Corporation think of purchasing the gas works. Three members are in favour of electric lighting, but their motion to reject a report in favour of purchasing the gas undertaking was negatived by seven votes to three.

Spain.—An installation of electric lighting has just been completed in the Tortilla mine at Linares. The municipal authorities of Almodovar del Campo (Ciudad Real province), lately invited tenders for the concession for the electric lighting of the town, but according to a Spanish contemporary not a single tender was received in response thereto.

Weybridge.—Some correspondence has been passing between the District Council and the Board of Trade regarding the provisional order obtained some time ago.

Wimbledon.—The Ratepayers' Association have passed resolutions in opposition to the electric lighting scheme recently adopted by the Council, and which is estimated to cost £32,000. A Local Government Board inquiry is to be shortly held.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

American Electric Railways.—A despatch from Boston says that the Lynn and Boston Street Railway Company will soon open and equip with electric power the old Beverly and Danvers road.

Another Electrical Tramway at the Isle of Man.—The prospectus of the Douglas Southern Electric Tramways, Limited, invited applications for an issue of 20,000 £1 seven per cent. preference and 10,000 £1 ordinary shares. The list closed yesterday. The company has acquired an exclusive concession for the construction and operation by the overhead wire system of an electric tramway upon the Douglas Head Marine Drive at Douglas, Isle of Man, upon the terms of paying to the Marine Drive Company 1d. for each passenger entering upon the Drive with a current tramway ticket. The concession is for a period of 10 years from April 2nd, 1895, at the expiration of which period the Douglas Head Marine Drive, Limited (grantors of the concession), have the option either to purchase the undertaking of this company upon the terms of paying to the company the sum of £30,000 for the first 2½ miles constructed, and a further sum at the rate of £10,000, or a proportionate part thereof, for every subsequent mile or part of a mile, or to extend the concession for a further period of 21 years upon agreed terms. The cost to this company of the first 2½ miles of tramways constructed and fully equipped upon the overhead wire electric system, for a five minutes service, with all necessary buildings, plant, rolling stock, &c., in working order, and including the concession, has been fixed at £29,000, payable as to £25,000 in cash, and £4,000 in ordinary shares or cash, at the option of the directors. The company has entered into a contract with the General Traction Company, Limited. Messrs. Kincaid, Waller & Manville are the consulting engineers, and the following are directors:—John Senhouse Goldie-Taubman, Esq., J.P. (Speaker of the House of Keys); William Turton, Esq.; William Paul James Fawcus, A.M.I.C.E. (managing director, The Altrincham Electric Supply Company, Limited); William Sebastian Graff Baker, Esq. (director, Coventry Electric Tramways, Limited); George William Lowcock, Esq., M.I.E.E. Messrs. Graff Baker and Lowcock, having been interested in obtaining the concession, will not join the board until after allotment. Mr. F. Rowe is the secretary, and the offices are at 71, King Street, Manchester, and 11, Athol Street, Douglas, Isle of Man.

Bristol Electric Tramways Extension.—The *Bristol Mercury* says that at the last Council meeting, on the motion of Mr. Howes, who rose on behalf of Mr. Fussell, a resolution of the Council passed a month ago was rescinded, and plans submitted by the Tramway Company for the extension of the line to Warmley Hill were approved. The added line will be double from the gates of the flower show field to the top of the hill, and will be laid in the centre of the road. The work was commenced on 17th inst.

Derby-Ashbourne Proposed Electric Railway.—A public meeting, held at Ashbourne last Saturday, further considered the proposal to lay a light electric railway between Derby and Ashbourne, particulars of which have already been given in our columns. The chairman stated that, under the present circumstances, the North Stafford Railway had the monopoly, and the promoters were therefore entirely in their hands. Mr. Shaw, jun., explained the scheme, and the meeting passed a resolution approving it, and recommending that the necessary Parliamentary powers be secured to form the company for carrying it into effect. A number of those present promised to subscribe towards the £700 necessary for the preliminary expenses.

Electric Traction in Austria and Hungary.—It is proposed to construct an electric tramway between Lippà and Savanynkut. Plans are being prepared for the construction of an electric tramway in the town of Arad. It has been decided to adopt electric traction on the horse tramways in the town of Temesvar. An overhead-conductor electric tramway is being constructed in the town of Fiumè. Messrs. Ganz & Co., of Buda Pest, have secured a 50-years' concession for the working of electric tramways in the town of Pressburg. An electric tramway is being constructed between Vorchdorf and Gmunden, a distance of about nine miles. A concession has lately been granted for an electric tramway between Fölling and Gratz.

Electric Traction in France.—Application has been made for a concession to construct and operate an electric tramway between Rochefort and Tonnay-Charente (Charente-Inferieure). The question of electric traction is under consideration at Versailles. It is also proposed to construct an electric tramway in the town of Pau, in the Lower Pyrenees.

Electric Traction in Germany.—A contract has just been secured by Messrs. Schuckert & Co., of Nuremburg, for the construction of an electric tramway between Velbert, Heiligenhaus and Hösel for passenger and goods traffic. It has also been decided to adopt electric traction on the tramway between Furth and Nuremburg.

Electric Traction in Italy.—A line of electric tramway between Varese and Prima Cappella, a distance of nearly four miles, has lately been completed and put in operation. The generating plant comprises two 100-H.P. engines and dynamos. The line is on the Thomson-Houston overhead conductor system. The electric tramway system in Rome has just been extended by the opening of a new line between the Piazza San Silvestro and the Piazza Termini.

Llandudno.—Mr. W. Kingsland has applied to the District Council for their sanction to the construction of an electric tram line to connect the two extreme ends of the town. The cars are to be worked on the storage system.

Railway Amalgamation in the States.—We learn that three extensive local street railway concerns have been amalgamated, *i.e.*, the Philadelphia, the Electric, and the People's. The title of the new company will be the Union Traction Company of Philadelphia.

Railways for Japan.—According to a London contemporary, there is a decided movement in laying new railways in Japan just now. Before the late war with China, many schemes were in hand, but as it seemed there would be such a demand for money for the war loans, a number of them were delayed lest capital might not be forthcoming. Now the war is ended, and matters are settling down to comparative quietude, the movement in favour of railways is reviving, and lines are in course of construction. Great Britain holds a good position in the provision of railway plant, and should not let the present opportunities slip by them. It seems to us that the present is a fitting time for British electric traction men to fight hard for supremacy in Japan in supplying electrical railways and tramways. The mind of the Japanese is open to real advancement in all directions, and, we believe, speaking generally, favours the use of electricity for both lighting and traction.

The Nantasket Beach Trolley Railroad.—According to a New York exchange, the Nantasket Beach Electric Railway, which was recently described in these columns, shows for the past summer's working an increase in receipts of 300 per cent. over that of the steam service of 1894. It is anticipated that 1896 will show even better results. The inhabitants of the districts through which the railway runs are delighted with the trolley system, and are wanting extensions. The railway officials, also, are very satisfied with the system and the results. Our contemporary considers this is not bad work for one season, and although it does not settle everything, it is pretty clear evidence that for short, frequent, and heavy passenger travel, electricity is better than steam on such roads.

TELEGRAPH AND TELEPHONE NOTES.

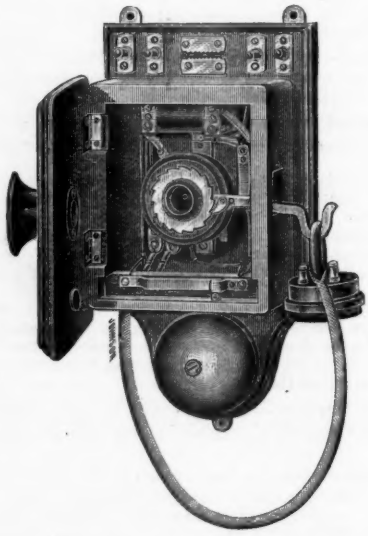
French Cable Matters.—M. André Lebon, Minister of Posts and Telegraphs, will, on the reassembling of Parliament, introduce a Bill in the French Chamber ratifying the contract concluded between the Government and the Compagnie Française des Cables Télégraphiques for the laying, maintenance and working of submarine cables between France and North America and the Antilles. By the term of the contract the French company engages to lay within two years a new direct cable between Brest and New York, having all the latest improvements. At the same time the company will maintain and, in case of need, replace the existing cable from Brest to New York, *via* St. Pierre, which has hitherto remained outside the administration of telegraphs. The company further undertakes, without involving the Government in any expense, to prolong the French trans-Atlantic cable to the Antilles by a new and independent cable from New York to Puerto Plata. At the latter point the cable will join the company's lines which serve the French colonies.

The *Financial News* says:—"It will make the mouths of our English transatlantic cable companies water to read the terms of the agreement which the French Government proposes to conclude with the Compagnie Française des Cables Télégraphiques for the laying, working, and maintenance of a new cable between France, North America, and the Antilles. The company is to lay a direct cable from Brest to New York, to renew, if necessary, the existing Pouyer-Quertier cable, and to extend both to the Antilles, by an independent line from New York to Puerto Plata. The cost of the new cable is estimated at 30,000,000 francs, and the Government will pay an annual subsidy of 800,000 francs, or 2⅔ per cent. on the capital outlay, until the returns reach 1,650,000 francs, or 5½ per cent., when the subsidy will be reduced. With such terms as these the French company ought, at least, to be above the necessity of cutting rates in future, and to avoid the unpleasant suspicion which at present attaches to it."

With reference to the question of England's monopoly of the cable system, the *Debats* says that by geographical situation France should be the telegraphic centre of the world, and were the Government to take the matter resolutely in hand, Paris, in the course of time, would out-distance everything as the general information office of the universe.

Interesting.—It is stated that Mr. Moses Taylor, the grandson of Moses Taylor whose name is coupled with that of Cyrus Field in laying the first Atlantic cable, is to marry a daughter of Mr. Cornelius Vanderbilt. Both parties are said to have fortunes of about $20,000,000.

Revolving Transmitter for Telephones.—Owing to the constant trouble experienced by users of even the best transmitters through the wedging or caking of the granulated carbon, Messrs. Gent & Co., of Leicester, have patented an arrangement by which the transmitter is partially revolved every time the instrument is used, thus causing a disturbance of the granulated carbon, and keeping the instrument always free. This is accomplished by an attachment connected with the switch hook, or as is found preferable, by a connection with the ringing key. The arrangement is very simple, and can be fitted to existing telephones with granular transmitters at a comparatively small cost. In conjunction with their "Hunnings-Grid" transmitter, which they have recently perfected, Messrs. Gent & Co. claim that this is a perfect telephone instrument. The accompanying cut shows the older method of connecting the transmitter with the switch hook.



The West Riding Telephone Service.—On 22nd inst. a meeting of the members of the Chamber of Commerce, and representatives of the other local Chambers, was held at Bradford, for the purpose of discussing the existing telephonic arrangements with a deputation from the National Telephone Company. Mr. W. L. Gaine was present, and made a lengthy statement. It was thought that unification of the service of six areas, *i.e.*, Huddersfield, Halifax, Bradford, Leeds, Wakefield, and Dewsbury, might lead to improvement. The meeting decided to memorialise the Postmaster-General, calling his attention to the unsatisfactory trunk line service, and laying the case generally before him.

The India Telegraph Department.—The additions during the year amount to 1,941 miles of line and 4,001 miles of wire, bringing the total to 44,648 miles of line and 138,256 miles of wire. The capital sunk in the operations of the Department amount to 374 lakhs of rupees. The gross receipts amounted to 80 lakhs of rupees revenue, expenditure 57 lakhs, giving 23 lakhs as the net receipts. Private traffic still continues to exhibit rapid progress, the number of private messages having increased during the year by 218,982. State inland telegrams decreased 2 per cent. in number, but increased 5 per cent. in value, the increase in value being chiefly due to the military operations in Chitral, including news free and *pro forma* revenue. The net receipts for the year are equivalent to a return of 3·89 on the total capital outlay. During the last 10 years the number of messages has increased 111 per cent., and their value over 96 per cent., the actual number of messages during the year being 3,200,000, making an increase of 1,700,000 during the ten years. The important lines completed during the year comprise the Srinagar and Astor connection, and also the connection between Bhamo and Momien, the frontier stations of India and China, thus establishing a direct overland telegraphic communication between the two empires.

The Berne Telegraphic Code.—Considerable objection is being raised to the compulsory use of this code for commercial telegrams, the code being stated to be hopelessly defective, badly compiled, and inferior to the majority of private codes in daily use. The whole question will come up for consideration at the International Telegraphic Conference, to be held at Buda Pesth next year.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bedford.—November 1st. The officials of St. Paul's Wesleyan Chapel are inviting tenders for electric lighting and other improvements. Particulars from the caretaker.

Belgium.—November 8th. The Municipal Authorities of Tongres have extended the date for the receipt of tenders for the concession for the electric lighting of the town from the 10th inst. until November 8th. Tenders to be sent to the Conseil Municipale, Hotel de Ville, Tongres.

London.—October 28th. The Postmaster-General is inviting tenders for the supply of red fir telegraph poles, to be delivered in London, King's Lynn, or Sutton Bridge, and at Northumberland Dock (River Tyne), West Hartlepool, Hull, or Grimsby; and also for creosoting the poles with 10 lbs. or 12 lbs. of creosote to the cubic foot, as may be directed. The poles to be felled between November 1st, 1895, and February 29th, 1896, and to be delivered during the following summer at the port at which the creosoting is to be performed. Particulars may be obtained on application to Chas. E. Stuart, Controller of Stores, General Post Office, London, E.C.

Madrid.—November 15th. The Director of Public Works is inviting tenders for the concessions of the construction and working of a tramway from Madrid to Colmevar Viejo, with branches to Chamartin and Rosa. Security 12,505 pesetas. Particulars at the Direccion General de Obras Publicas (Ministerio de Fomento), Madrid.

Rangoon.—November 4th. The Municipal Committee is inviting tenders for electric lighting. Particulars to be obtained from Messrs. Ogilvy, Gillanders & Co., 67, Cornhill, E.C.

Saltash.—October 26th. Tenders are invited by the Town Council for lighting with gas, electricity, or otherwise the public lamps in the Borough, from January 4th, 1896, for such term as may be agreed upon.

Vienna.—November 14th. The Municipality of Vienna asks for tenders and plans for the construction and working of electric railways in and around the city. The notice may be seen at the Commercial Department of the Foreign Office.

CLOSED.

Ayr. — Of three offers sent in for wiring the town properties, that of Messrs. W. G. Higgs & Co. for wiring has been accepted.

Harrogate.—We stated last week that the tender of Messrs. Paterson & Cooper had been accepted for wiring the new baths at Harrogate for electric lighting. The following is a list of the tenders that were sent in:—

	£	s.	d.
Howe Electric Engineering Company	1,299	0	0
Lund Brothers	1,166	18	0
Petit & Hards	998	0	0
Sharp & Kent	875	10	0
Ullathorne & Hartley	850	0	0
C. A. Parsons & Co.	835	0	0
G. Steinthal	750	0	0
Fowler, Lancaster & Co.	743	8	0
Dixon & Sons	712	7	6
Northern Counties Electric Company (G. Clark) ..	687	0	0
Beanland, Perkins & Co.	659	17	6
Reg. Falshaw	642	0	0
Chas. Dawson	599	14	9
Lomax, Kendal & Co.	571	6	0
Maunsell, Mercer & Co.	560	0	0
Waring & Co.	425	0	0
Paterson & Cooper	412	0	0

Gravesend.—From the tenders sent in for supplying and fixing telephones, &c., for the Town Council that of Messrs. Paterson and Cooper for doing the work for £47 10s. has been accepted. There is also to be a charge of £2 10s. per annum for maintainance.

London, E.C.—From the tenders sent in for wiring the Cripplegate Institute for electric lighting, that of Messrs. F. A. Glover & Co. was accepted, the amount being £369 11s. This does not include the electroliers, fancy fittings, or portable lights. Mr. B. H. Jenkinson, A.M.I.E.E., is the engineer. The total number of lights is 311.

Richmond (Surrey).—The following tenders were sent in for fire-calls extension to Kew and Petersham, for the Town Council:—

	£	s.	d.
Newland & Co.	371	0	0
Harrison, Coles & Co.	317	5	0
Consolidated Telephone Company	299	10	0
J. Sax & Co.	250	0	0
Callender Company, for cables only (accepted) ..	165	6	0
Stewart, for instruments only	46	7	6

NOTES.

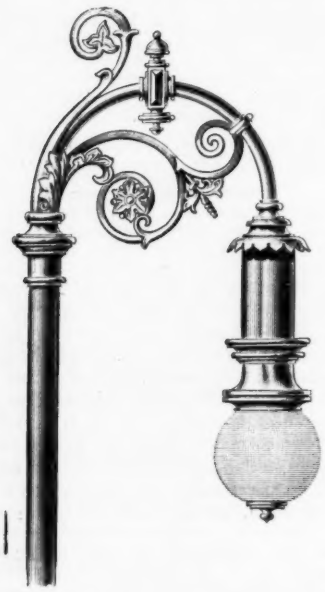
The Electromotor in Berlin and Vienna.—Although the application of electric power to industrial purposes was unknown in Berlin a few years ago—the first installation having been connected to the network of the Berlin Electric Supply Company in 1890—this kind of power has come so quickly into favour in industrial circles that on June 30th of this year 663 electromotors, with a total output of 2,365 H.P., were supplied from the Berlin central stations, and orders were in hand for motors with an output of about 200 H.P. The electromotors are applied to a great variety of purposes as the following table will show:—

	Number of motors.	Horse-power.
Printing presses	146	546
Lifts	139	834
Ventilators	135	180
Metal work machinery	55	196
Butchers' machinery	25	92
Grinding and polishing machines... ...	21	100
Woodworking machinery	17	70
Paper machinery	14	41
Cloth cutting machines	10	9
Electroplating	6	15
Hatters' machines	6	7
Sewing machines	6	2
Spool machines	5	5
Leather machinery	4	25
Washing machines	3	14
Miscellaneous	70	229

These motors, in the year ended June 30th, were supplied with about 1,230,000 H.P. hours by the Berlin electric works. Recently the electromotor has been largely used in the building trades on account of its transportability. They have been found specially adapted for driving travelling cranes, pumps, and concrete making machines. In Vienna, there were 138 motors supplied by the three electric supply companies at the beginning of 1894. This number had increased 298 by the end of 1894. The principal applications of these motors were in the metal work, bookbinding and printing trades, but to a less extent they were used in a great variety of trades in which small motive power is required.

Electro-Therapeutics. — Some interesting experiments have recently been made in the application of weak galvanic currents to the treatment of nervous disorders of the stomach. The galvanic currents are applied directly to the stomach by means of a specially designed electrode, which is swallowed by the patient. This electrode, invented by Dr. Einhorn and modified by Dr. Ewald, consists of an India-rubber tube 1 mm. thick, which terminates in a perforated vulcanite capsule, and contains the conducting wire. The conducting wire does not quite reach to the perforated capsule, but only goes far enough to dip into the water in the stomach. After the patient has drunk two glasses of luke-warm water, the electrode is introduced and connected with the negative pole of the galvanic battery. The strength of current employed is from 15 to 26 milliampères, and the duration of the sitting five minutes. The success of these experiments was such as to secure a place for the method in the treatment of nervous disorders of the stomach and bowels.

Tunbridge Wells Street Lighting.—In our description of the plant used in connection with the Tunbridge Wells electric lighting, we omitted to give particulars of the arc lamps used for lighting the streets. There are altogether about 30 lamps to take a current of 10 ampères; they are of the "Brockie-Pell" single carbon type for 16 hours, and are



run in series from the Ferranti rectifiers, which we have already described. The kind of lamp and bracket in use is shown in the accompanying illustration. Messrs. Johnson and Phillips have lately issued a new catalogue of the different types of "Brockie-Pell" lamps, giving a number of excellent illustrations, and drawing attention to reductions in the prices.

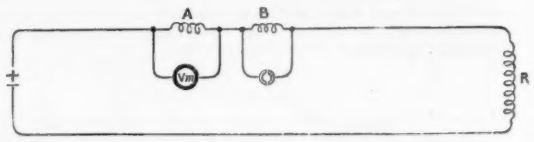
Pyrometers. — Messrs. W. C. Heraens, Keiser, and Schmidt, of Berlin, have recently brought out a pyrometer formed of a platinum-rhodium thermo couple, which seems likely to be a reliable instrument. The main question was to produce any desired amount of platinum and platinum-rhodium wires of the same purity and composition, and of the same thermo-electrical value. The Phys. Techn. Reichsanstalt has undertaken the comparison of all the wires to be used for the elements with the thermo-elements connected with a standard air thermometer, and a great number of these compared elements has been completed. Each element consists of a platinum wire 1·5 metre long and 0·6 mm. thick, joined with an equally long and equally thick wire of 10 per cent. platinum-rhodium alloy. The junction of the wires forming the thermo-electric couple is perfected by melting both metals directly together, all foreign metals being excluded. The galvanometer (of the D'Arsonval type) gives readings corresponding to temperatures of from 500° C. to 1,500° C. The galvanometer is constructed in such a manner that the needle covers two scales, of which one shows the electromotive force in volts (so that the constancy of the instrument can always be checked), while on the other scale the degrees of temperature can be read direct. The tests which have been made with the new pyrometer at different places, amongst others in the Royal Porcelain Works, in Berlin, are stated to have been satisfactory in every respect.

The British Aluminium Company.—It is stated that this company, not content with having secured the Falls of the Foyers much to the annoyance of the *Daily Chronicle*, are now negotiating for the water power of the Falls of the Clyde. The company propose to use the Bonnington and Corra Linn Falls, leaving Stonebyres alone. The negotiations have proceeded satisfactorily so far as the Aluminium Company is concerned, although a slight hitch has occurred with one of the proprietors of the estates on which the Falls are situate.

Prof. George Forbes and Niagara.—Judging by what the New York technical press has said, Prof. Forbes is held in great contempt by Americans just at present. The recent unbridled criticism to which he has been subjected on both sides of the Atlantic is considered a well-deserved return for the egotistical manner adopted by him in his article in *Blackwood's Magazine*. The New York *Electrical World*, in a leading note, speaks of "his lack of judgment," and "his hot-headed contributions to the unfortunate Niagara controversy." Our contemporary also says:—"His letters to English journals, and his article in *Blackwood's Magazine*, so manifestly betray an excited and irritable state of mind, that they might be passed by in charitable silence, were it not for the many uncalled-for disparagements contained, not only of individuals, but of Americans in general." Further, the same contemporary says:—"His condescending references to 'my millionaires,' and the lordly tone otherwise adopted in this connection, would seem to indicate that no quarter is to be given to any concerned with the project that to him has apparently entailed so much bitterness." New York *Electricity* led the attack a week previously by a very pointed criticism reviewing the whole matter so far as Prof. Forbes's connection with it was concerned.

High Voltage Shocks.—Referring to an article in the *Electrical World* some months ago, Mr. Nizzola in *L'Elettricista* for September, states that in the high voltage plant installed in Frankfort, Germany, a workman was carrying out some repairs in the distribution system when he touched a bare copper wire while standing in good contact with the ground; the wire was connected with the middle conductor of a concentric cable, the external conductor of which was maintained at about the same potential as the earth, owing to the capacity effects, the length of that circuit being 18 miles; he thus received a shock from 2,900 volts; he immediately fell to the ground and remained half an hour apparently dead; a bright spark was seen when he broke contact; artificial respiration and throwing cold water on the breast gradually restored life, but he remained for a whole day in a dazed condition; he resumed his work again the next day with no other effects remaining but a bad burn on the hand; he had no recollection whatever of the accident. The author strongly recommends the injection of sulphuric ether which he recommends that every electrician should carry in his pocket, together with the necessary appliances for the purpose; the injection should be made under the skin near the heart.—*Electrical World* "Digest."

A Percentage Method for Circuit Measurements.—At the recent annual convention of the Canadian Electrical Association, Mr. Keeley described a simple method of determining the resistance of a circuit, which is deserving of record. The method, which is adapted for both direct and



alternating currents, is as follows:—A and B are two known resistances included in the circuit to be tested, and V is a voltmeter, shunted by A. By measuring the voltage at the ends of A with B first in circuit and then out of circuit, the percentage which B bears to the entire resistance is obtained, and therefore the entire resistance of the complete circuit accurately determined.

North-East Coast Institution of Engineers and Shipbuilders.—At the first meeting of the 1895-96 session to be held to-day at Newcastle, a paper on the "Surface Condensing Plant at the Newcastle and District Company's Electric Works, Forth Banks, Newcastle-on-Tyne," will be read by Mr. W. Cross.

"Dr." Verity.—The author of "Electricity up to date" is referred to by the *Hospital* as *Dr.* J. B. Verity. We have looked upon the Veritys as veritable sportsmen and first class electricians, but were not aware that Mr. J. B. Verity combined, with his many other qualifications, those of a doctor.

Uniformity in Switches and Fuses.—A report of a committee of the German Union of Electricians is published in the *Elek. Zeit.*, September 5th. Their recommendations, which have been formally adopted by that body, are as follows:—Screws for fuses, switches, instruments, &c., should be made of the following sizes:—

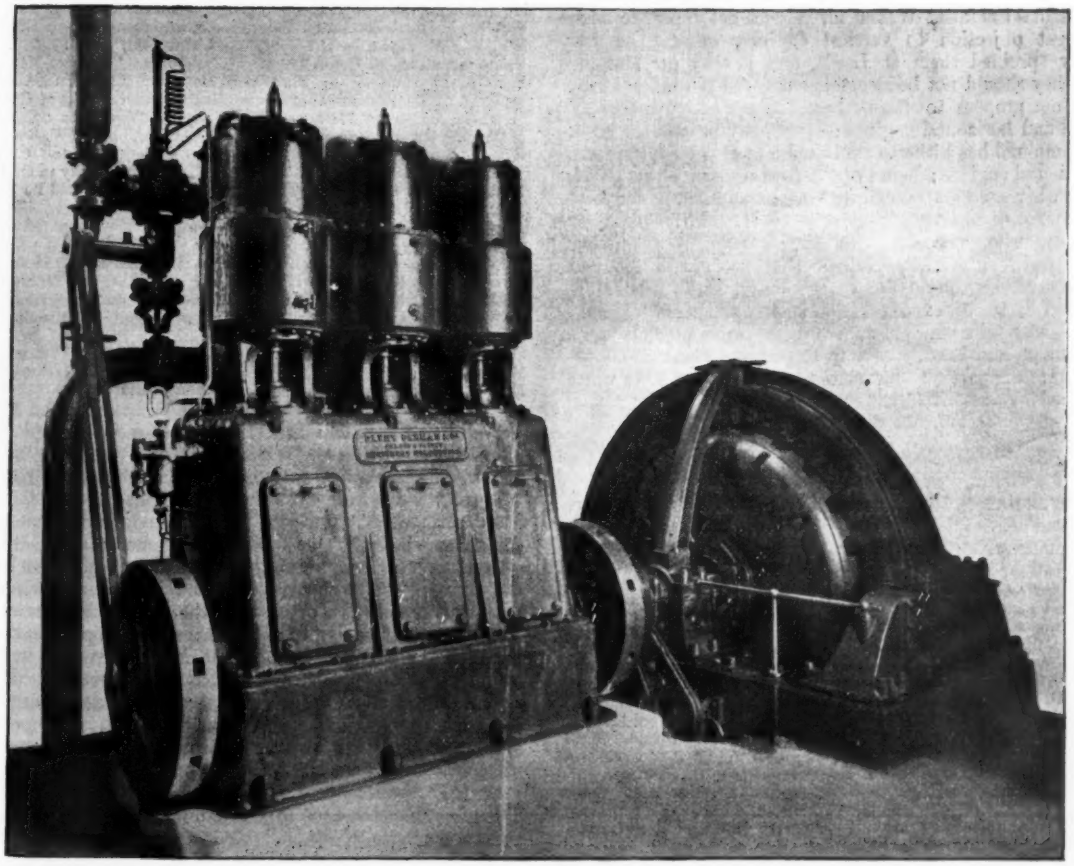
50	100,	200,	400,	700,	1,000 ampères.
$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$ inches.

(It appears that from 50 ampères upward this refers to iron screws.) Lead fuse plugs are to be made in six sizes, so as not to be interchangeable, each two sizes differing 2 mm. in length, as follows:—For 1, 3, 6, 10, 15, and 25 ampères the length of the plugs, of the Edison type, are to be 31, 29, 27, 25, 23, and 21 mm.; for lead strip fuses the distance between the centres of the screws for 50, 100, 400, and 1,000 ampères, respectively, are to be 70, 80, 95, and 110 mm. The following scale of sizes of wires is to be used, the numbers giving the cross-section in sq. mm., 1, 1·5, 2·5, 4·6, 10, 16, 25, 35, 50, 70, and 95; the same scale of currents above given are to be used in general for designating and specifying apparatus. As no satisfactory results were reached regarding standards of lead strip fuses, a prize of $75 is offered for the best solution of the problem.—*Electrical World* "Digest."

A 200-hour Arc Lamp.—An exhibition of Jandus arc lamps was given yesterday by Messrs. Drake & Gorham at the Charlton Works of Messrs. Johnson & Phillips. We hope to describe this lamp fully in a succeeding issue, and till then we will reserve our opinion on some very peculiar features which, in the absence of any photometric data, seem to us to require explanation.

Students as Car Conductors.—A New York exchange records an incident which speaks well for the energy of the students to whom it refers. During the past summer between 30 and 40 students of several Philadelphian colleges obtained employment as conductors on the cars of the People's Traction System of Philadelphia. All of the young men were working their way through college. The last of them handed in their resignations a few weeks since, much to the regret of the company, for the young men had proved to be the best conductors in its employ. An official of the company said the students were thoroughly honest, intelligent and polite, and as their desire was to earn as much money during the summer as possible, they were always willing to work extra hours, and take out special cars. They lived economically, and have probably saved something like $130 each, which will go a good way toward paying their college expenses next winter. One of the students has not yet decided whether to go back to college; he likes railroading so well, and is still in the employ of the company.

The New Engine.—The Empire of India Exhibition closes to-morrow, so for the benefit of those who may not have seen, nor are now likely to see, the new high speed engine, described on another page, we herewith give an illustration of one direct coupled to a Mordey alternator.



A 12,500-Volt Generator.—A record was established at Deptford, on Monday, by the 1,000-unit machine recently erected by Messrs. Ferranti, when it delivered current at 12,500 volts. This is, to our knowledge, the highest E.M.F. ever developed by a machine. The machine was put on the ordinary lighting circuit on Tuesday for six hours, the running being remarkably steady.

The Noble Trolley.—A Sandford (U.S.A.) paper says that the trolley is doing a noble work. Last week it killed 13 dogs in East Street. No obstacles are to be placed in the way of completing the trolley's humane task.

The Wakefield Tenders.—Judging from the *Wakefield Herald* of last Saturday, the tenders were by no means amicably agreed to. Our contemporary states that

In consequence of the council resolving into committee, the proceedings, which occupied nearly two hours, are unreported. It has since transpired that the engineer to the scheme, Mr. Hammond, who was present, went through a somewhat severe cross-examination at the hands of Councillor Reynolds, and as the replies evoked were not such as to satisfy Councillor Reynolds, that gentleman, although he had previously voted with the electric lighting committee on the question, stated that he felt it to be his bounden duty on the present occasion to propose an amendment to refer the minutes back for reconsideration, Councillor Henry Smith seconding. The principal point at issue was the question of the adoption of vertical engines as against the horizontal engines recommended by the committee. Councillor Reynolds, who is said to have had considerable experience in the working of engines, upheld the desirability of introducing vertical engines for the electric lighting plant in this city. He contended that the committee, having only visited Burton-on-Trent, Dewsbury, and Leeds, had not gained sufficient experience as to the relative merits of the two classes of engines to justify them in coming to a conclusion that evening, and that there were places where more modern installations than those already visited might be seen.

We give this entirely on the authority of the *Herald*, but we do know, for a fact, that a scheme including vertical engines was submitted, which was some £1,300 less than the horizontal engine scheme. Although the engineer specified for horizontal plant at Wakefield, he does not appear to have any great objection to vertical engines, because he has actually specified them at Leeds, and if they are suitable there, they should not be altogether unfitted ten miles away. We do not propose to discuss here the respective merits of vertical and horizontal engines; much may be said for both. Mr. Hammond has hitherto exhibited a most unyielding faith in horizontal engines; he may have good reasons for his belief, but it rather argues an unwillingness to admit the merit of other types of alternating current plant. Mr. Councillor Reynolds, who, according to the *Herald*, is in favour of vertical engines, complained that the committee had only visited Burton-on-Trent, Dewsbury, and Leeds. If any good is to be expected from these wanderings of committees, why visit two places where the same plant is used, viz., Burton and Leeds; and to inspect the plant at Dewsbury, which is a direct low pressure system, is a mere waste of time. The committee may have obtained some information of rope-driven plant, but they cannot be accused of making their inquiries too wide. Yet, no doubt they conceive that they have done their duty to the Council and to the ratepayers.

Alternating v. Continuous Current Distribution at Niagara Falls.—Writing in the New York *Electrical Engineer*, J. C. Henry says :—

The controversy on this subject from the London *Times*, published in the *Electrical Engineer* of the 21st ult., is of a spicy nature, and the slaps at Lord Kelvin seem to be discourteous and out of place. The scheme to utilise the power of Niagara for electric purposes was, I believe, first given prominence by Lord Kelvin, when some 16 years ago he appeared before a Committee of the House of Commons, and talked on the subject of long-distance electrical transmission. Taking the power from Niagara Falls as an example, later in his inaugural address before the British Association in 1881, he went more into the details of the scheme, and explained how this enormous force might be controlled and utilised in New York City. A continuous current was to be generated at the Falls, an electrical pressure of 80,000 volts was to be used to charge 40,000 accumulators in New York. These were to be switched on to the local circuits in sets of 50. I know of no theoretical objection to this scheme. It possesses many advantages over the alternate current system which has recently been constructed. I need mention but a few of them :—1. Temporary derangement of the generators or long circuits would not affect the consumption circuits. 2. The load on the dynamos and supply wires being constant, their size and cost would probably be not over one-third of those of the proposed plant. 3. The potential and kind of current desired by the consumer could be secured *for any desired purpose* without transformers or rectifiers. In the *Times* controversy referred to, Silvanus P. Thompson says :—"Lord Kelvin's prepossession in favour of continuous currents as against alternate currents is not supported by modern electrical practice, save for the restricted purpose of electrolytic decomposition. On the contrary, for *nine-tenths* of all other purposes the advantage is found to lie on the side of the alternate currents wherever the distance of transmission exceeds a few hundred yards." As Prof. Thompson's correspondence refers to an American installation, I presume he refers to American practice. His figures are wide of the mark—about 70 per cent. of the entire current generated in this country is used to operate electric railway motors, none of which could use alternate currents; 90 per cent. of the arc lights used in America require direct currents. In New York City the Edison Company, which uses the direct current, seems to pay better dividends than those using the alternate current. The present Niagara plant will doubtless be a theoretical and commercial success; should it fail, the company have other resources, among them the fascinating scheme suggested by Lord Kelvin.

Electro-Therapeutics in America.—A few weeks ago we published a list of the papers read before the American Electro-Therapeutical Association at their annual gathering, and we then remarked how industrious our trans-Atlantic friends are in electro-medical matters. We have additional evidence of this in the programme of the National Society of Electro-Therapeutists, which held its third annual meeting at Boston in September. The president, Dr. W. L. Jackson, devoted his address to "The Development of Electro-Therapeutics, and its Relation to the Practice of Medicine." Papers were read as follows :—

"Some Experiments on Cataphoresis and Anaphoresis," by Prof. W. H. King, M.D., and Dr. F. M. Frazer; "Catalytic Effects of the Galvanic Current," by Dr. C. P. Hunt; "Is the Practice of Electro-Therapeutics a Fad Practice?" by Dr. E. S. Bailey; "Electricity in Dyspepsia," by Mr. T. G. Lajoie, M.D.; "The Difficulties of Utilising Commercial Currents for Therapeutic Purposes from an Electrician's Standpoint," by T. F. Livingstone; "Treatment of Rheumatism by Electricity," by C. G. Higbee, M.D.; "The General Therapeutic Effect of the Alternating Current of High Frequency and High Tension," by G. Apostoli, M.D.; "The Electrical Treatment of Locomotor Ataxia," by Prof. W. H. King, M.D.; "The Selection of the Current in the Treatment of Neuritis," by N. B. Delamater, M.D.; "Mitigating Effects of Spinal Galvanisation upon the Subjective Symptoms of Tabes," by F. C. Richardson, M.D.; "Do Electric Currents Affect the Spinal Ganglia?" by E. P. Colby, M.D.; "Faradic Polarity—A Problem," by F. M. Frazer, M.D.; "The Disintegration of Organic Tissues by High Tension Currents," by J. G. Parsons, M.D., of London; "Polyphased Currents and Their Effects," by Prof. W. L. Puffer; "Polyphased Currents," by Profs. E. J. Houston and A. E. Kennelly, of Philadelphia; "Electro-Magnetic Basis of Physiology," by Prof. A. E. Dolbear; "The Fundamental Relation of the Sinusoidal or Undulating to Other Forms of Current in Their Action on Nervous Tissue," by W. Y. Cowl; "Cases of Malignant Growth Treated by Electro-Puncture," by L. W. Reading, M.D.; "Some Points in the Treatment of Stricture of the Urethra by Electrolysis," by Prof. W. H. King, M.D.; "Electricity in Orificial Treatment," by C. A. Weihick, M.D.; "Hypertrichoses and its Treatment by Electrolysis," by J. L. Coffin, M.D.; "Notes on Electro-Therapie," by Drs. G. Gautier and J. Larat; "Treatment of Procidentia Uteri by the Faradic Current," by G. E. Percy, M.D.; "Electrical Treatment of Dysmenorrhœa," by Emily K. Bruce, M.D.; "A New Method of Dilating with Faradism," by Jeannie W. Martine, M.D.; "Electricity as a Means of Diagnosis in Gynæcology," by Dr. G. Apostoli; "Reports of Gynæcological Cases," by Minnie C. T. Love, M.D.; "Electricity in Diseases of the Pharynx," by T. L. Shearer, M.D.; "The Proper Application of the Electric Cautery for Nasal Diseases," by W. A. Dunn, M.D.; "The Use of Galvanism in Diseases of the Larynx," by J. B. Garrison, M.D.

Invention of the Electro-Magnetic Telegraph.—In his contribution to the series of papers published in the *Electrical World*, Mr. A. M. Tanner concludes as follows: "As early as the year 1837 the French Academy of Sciences had a permanent commission on electric telegraphs, composed of Arago, Becquerel and Savary. None of these distinguished savants ever questioned the claim of Morse to being the inventor of the electro-magnetic telegraph, and whatever may be said as to the date when the alphabetical code was first thought of, it is clear that there is no published nor acceptable proof that anyone but Morse invented it. An unbiassed or impartial opinion, based on proof, is that the essential features of the modern electro-magnetic telegraph, viz., the electro-magnet, the armature with its retracting spring, transmitting signals by a finger key, and reading them by sound, were invented or proposed by Morse in the year 1838, and made known to the public at that time. Therefore, let Morse for ever be considered the father of the electro-magnetic telegraph."

Fly-wheel Accidents.—At the Hudson Electric Light Company's station at Hoboken, N.J., recently, a fly-wheel burst, partially wrecking the premises. A short circuit on the line blew the fuses while they were replacing; the engineer slowed down the speed of the engine by *raising and holding up the governor*. The new fuses had no sooner been replaced, however, when they blew again, and the engineer becoming "rattled," in order to slow the engine down again, held the governor *down*. The result was natural, and the engine raced until the fly-wheel burst. The unfortunate engineer paid with his life the penalty of his carelessness. But it seems hardly credible, says the New York *Electrical Engineer*, that anyone should take such a means of reducing an engine's speed, instead of shutting off the steam at the valve. It is to the credit of Chief Engineer Bonta that, with the accident occurring at 4 in the morning, by 6 o'clock the gaping holes in the brick walls had been nearly closed, the roof entirely replaced and covered, the steam connections re-established, and current turned on the lines again.

Acetylene: its True Commercial Significance.—When it was discovered that by heating a mixture of coal and lime or charcoal and chalk in an electrical furnace a compound resulted which upon being thrown into water evolved acetylene the gas companies indulged in raptures. Here at least (they comforted themselves with the thought) was a cheap and easily procurable substance for mixing with their own product and thus raising its illuminating power. It has been our sad duty to point out the fallacies upon which such conclusions are based. On the authority of our esteemed contemporary, the *Electrical Engineer* of New York, we gather that the pioneers of electrically produced acetylene are presumably abandoning the problem of enriching gas, and are actively engaged in demonstrating that by means of it we may achieve the cheaper manufacture of innumerable substances which are used in the arts but which up to the present have been matters of pure chemistry. Thus acetylene, on being passed through an iron tube heated to *dull* redness, goes rapidly and completely into benzine. This is a product of prime importance and is the base of thousands of organic substances. In illustration of the transmutations which can be effected, it may be pointed out that if the resulting benzine vapour be passed into strong nitric acid it is transformed into nitro-benzine, and this on treatment with hydrochloric acid and iron filings goes into aniline. With the formation of aniline the road is opened for the production of the immense series of dye-substances of which aniline is the starting point. Instead of transforming acetylene into aniline, however, it may be transformed into carbolic acid; thence it is but a step to picric acid, the foundation substance of many of the modern high explosives. Or it may be made into aniline and then boiled with acetic acid, when it is transformed into anti-fibrin, the well-known fever specific. Again, by passing it through a tube heated to *bright* redness napthalene is produced, which is also the starting point of innumerable valuable chemicals. It would seem as though almost all the needs of man were able to be satisfied by this protean substance, acetylene. We are sure that some of our readers will note with interest that by the action of nascent hydrogen acetylene becomes ethylene, and this on treatment with sulphuric acid and water becomes *alcohol*, which apart from its other uses which need not be suggested, is absolutely necessary to the production of an enormous number of economic substances. In similar ways we can get such deadly poisons as oxalic acid and prussic acid, whilst acetylene is a cheap source of the aldehyde so much used to-day in the production of artificial essences and the manufacture of mirrors. So the electric furnace enables us to get acetylene whence we can cheaply produce whole systems of dyes, medicines, essences, perfumes, poisons, explosives, &c. In these directions the latest product of the electrical furnace has a utility out of all proportion greater than that which can be derived from its peculiar light-giving powers.

Electric Hair-Brushing.—A correspondent writes:—"I had occasion the other day to visit the wilds of north-east London, and on returning to my station, the name of which is spelt with an aitch, though apparently that initial letter is quite superfluous, my attention was attracted by an advertisement, from which I extracted the following:—

——'S ELECTRIC HAIR-BRUSHING.

By exciting the functional activity of the nerves, the hair bulbs are quickened into life when the electric pole touches the surface of the scalp, and at once stops the hair falling off.

No Extra Charge.

The greatest stimulant we possess is electricity.

The advertisement was illustrated by the representation of a gentleman in the act of having his hair bulbs 'quickened into life,' and, to judge from the expression of his countenance, the operation must have been a trying one for the facial muscles. Seeing that the establishment was not a thousand miles from the terminus for which I was bound, I determined to try the treatment for myself. It was a large saloon, with induction coils fitted round the walls and corresponding in number with the seats, which seemed to indicate that a good many people believed in 'exciting the functional activity of the nerves.' Having had a good crop, 'Would I have a shampoo?' was the question, 'or a singe?' 'or bay rhum?'—the latter being in a bottle aggressively labelled, '6d. extra.' I was assured that the current would have no effect unless the head was wetted. 'Wouldn't a singe afford the necessary preparation?' I suggested; but the attendant was not to be caught, so I submitted. The electrodes were connected with the primary circuit of the coil, one terminating in a handle to be held in the hand, and the other in the metal 'haired' brush. That the treatment has an effect on the nerves is quite true, the feeling being neither very pleasant or very unpleasant; whether it is any use is another matter, and one which it would be interesting to have authoritative opinion upon."

NEW COMPANY REGISTERED.

British Electrical Manufacturing Company Limited (45,680).—This company was registered on October 18th with a capital of £20,000, in £5 shares, to manufacture, sell and deal in telephones, telegraphs, electric bells, phonographs, elevators, carbons, insulators, wire, glass vulcanite and other apparatus. The subscribers (with one share each) are:—C. Capps, 268, Cornwall Road, W., clerk; H. D. Monk, 2, Catherine Villas, Sunbury, clerk; F. C. Smith, 10, Hunter Street, W., secretary; J. Hill, West Hill Road, Wandsworth, clerk; J. Davis, 2 and 3, West Street, Finsbury, solicitor; F. A. Braithwaite, 316, King Street, Hammersmith; C. A. Cox, 24, Cleveland Gardens, W., secretary. The number of directors is not to be less than two, no more than seven; the subscribers are to appoint the first. Qualification 20 shares; remuneration £1 1s. each per meeting attended. Registered office 107, London Wall, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chili Telephone Company, Limited (29,252).—This company's annual return was filed on August 29th. 44,000 shares have been taken up out of a capital of £250,000, in £5 shares; the full amount has been called, and £220,000 has been paid.

National Company for the Distribution of Electricity by Secondary Generators, Limited (18,309).—This company's annual return was filed on September 4th. The capital is £500,000, in £10 shares (3,000 preference). 2,669 preference and 20,000 ordinary have been taken up, and 1,000 preference and all the ordinary considered as paid. Full amount has been called on the other preference, and £16,690 has been paid. £1,000 has been paid in addition in respect of 100 forfeited shares.

Halifax and Bermudas Cable Company, Limited (28,972).—This company's annual return, which was filed on October 10th, discloses the fact that the capital of £50,000 in £5 shares has been considered as paid.

Richmond (Surrey) Electric Light and Power Company, Limited (36,782).—This company's annual return for 1894 has just been filed. 4,066 shares have been taken up out of a capital of £50,000 in £5 shares, and £20,330 has been paid.

Harrington Electric Light Company, Limited (44,135).—This company's statutory return was filed on October 7th. The 2,000 shares of £1 each forming the capital have been taken up, and £500 has been called and paid.

Economic Electric Specialty Company, Limited (41,561).—This company's registered address was by notice filed on September 26th, removed to 9, Queen Anne's Gate, Westminster, London, S.W.

Crompton & Co., Limited (27,200).—This company's annual return was filed on September 5th. The capital is £280,000, divided into 30,000 preference and 26,000 ordinary shares of £5 each; 28,180 preference and 5,928 ordinary have been taken up, and 4,000 ordinary have been issued as paid. The full amount has been called on the preference, and £1 per share on the ordinary, and £142,819 has been paid, leaving £33 in arrears; £24 has been paid in advance of calls.

Round's Accumulator Company, Limited (45,288).—The registered office of this undertaking, according to a notice filed on September 19th, is now situate at Broad Street House, New Broad Street, London, E.C.

Spanish Telephone Company, Limited (41,589).—This company has just filed its annual return, which shows that the capital of £16,000 in £10 shares has all been taken up and issued as fully paid.

Spanish National Submarine Telegraph Company, Limited (18,321).—This company filed its annual return on August 31st. The capital is £500,000, in 49,900 £10 shares and 1,000 £1 shares, and 23,719 of the £10 shares have been taken up, 23,715 have been issued as fully-paid, and the full amount has been called and paid on the other four shares.

Veale & Co., Limited (36,512).—This company's annual return has just been filed. 4,904 shares have been taken up out of a capital of £10,000 in £1 shares, 3,839 have been issued as paid, and £1,065 has been paid in respect of the others.

Siemens Brothers & Co., Limited (14,777).—This company's annual return was filed on August 27th. The whole capital of £500,000, in £100 shares, has been taken up, £85 per share has been called, and £425,000 has been received.

CITY NOTES.

The Brazilian Submarine Telegraph Company, Limited.

The report of the directors and the accounts for the half-year ended June 30th, 1895, to be submitted to the 44th ordinary general meeting October 30th, 1895, states that the revenue for this period amounted to £108,205 14s. 5d. and the working expenses to £21,129 4s. 11d. After providing £3,200 for debenture interest and sinking fund, and £1,790 1s. for income-tax, there remains a balance of £82,086 8s. 6d.; to this is added the sum of £4,324 0s. 9d. brought forward from December 31st last, making a total of £86,410 9s. 3d. A quarterly interim dividend, amounting to £19,500, has been paid, and £30,000 transferred to the reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £32,500, leaving a balance of £4,410 9s. 3d. to be carried forward. The dividend and bonus will be payable on the 31st inst. The receipts for the half-year include the sum of £1,500 dividend to December 31st, 1894, on the company's shares in the African Direct Telegraph Company, Limited. The various sections of the company's lines are in good working order. Lord Sackville A. Cecil and the Duke de Loulé retire at this meeting, and being eligible for re-election as directors, offer themselves accordingly. The auditors, Messrs. Deloitte, Dever, Griffiths & Co. and Messrs. Gane, Jackson and Jefferys, also offer themselves for re-election.

Froggatt's Electric Lighting Company, Limited.

An extraordinary general meeting of this company was held on Monday at Winchester House, Mr. A. de Murrieta in the chair, to consider resolutions expressing the desirability, on the suggestion of the directors and in the opinion of the shareholders, of appointing a committee of shareholders to confer with the directors on the following subjects:—The conduct of the business in the past, and the causes of a dividend not having been earned; the conduct of the business in the future, and the steps to be taken to promote the business success of the company; and empowering the committee, "if in its discretion it thinks fit, to make a report to the shareholders."

The Chairman proposed the first resolution.

Mr. Keeble desired to hear some explanation of the necessity for the proposed committee.

Mr. Wildey, a shareholder, seconded the resolution. With respect to Mr. Keeble's remarks, he thought the report recently presented to them spoke for itself. He saw the light in the omnibuses and elsewhere, and he desired to know where all the receipts had gone to, the report of the directors showing a profit for the year of only £239.

Mr. Keeble stated that at the last meeting the chairman explained the reasons why a dividend had not been paid. He believed that what was proposed would wreck the company. He moved an amendment providing, in effect, that if the committee were appointed, they should report to the shareholders the result of their conferences.

Mr. Hayward seconded the amendment, to which he proposed an addition limiting the time within which the committee's report should be presented to 28 days.

The Chairman said that if the period were limited to 28 days, the directors would oppose the amendment, to which they had no objection in other respects. Their object in leaving it to the discretion of the proposed committee to report or not to the shareholders the result of their conferences was that certain subjects might be discussed the publication of which might be detrimental to the company.

The Solicitor said he thought that the simplest course to take would be to put the amendment.

The amendment was therefore submitted to the meeting, and the Chairman declared it lost. He afterwards put the original motion, and declared it carried. A poll was, however, demanded, which the chairman said would be taken; and the meeting was then adjourned until yesterday, at 4 o'clock, to declare the result.

Eastern Extension Telegraph Company, Limited.

The directors, in their report for the half-year ended June 30th last, state that the gross receipts, including Government subsidies, have amounted during that period to £264,138, against £247,681 for the corresponding half-year of 1894. The working expenses, including £29,323 for cost of repairs to cables and expenses of ships, absorb £95,254, against £80,295 for the corresponding period of 1894, leaving a balance of £168,883. From this is deducted £3,984 for income-tax, £31,895 for interest on debentures, debenture stock, and contribution to sinking fund, leaving £133,004 as the net profit for the half-year. Two quarterly interim dividends of 1¼ per cent. each, amounting to £62,500, have been paid for the half-year under review, leaving £70,504 to be carried forward. The working of the Australasian tariff arrangement for the fourth year of guarantee, ended April 30th last, resulted in the guaranteed figure being slightly exceeded, owing to the exceptionally heavy gold mining traffic that was exchanged with Australasia during the latter part of the year. The maintenance ships have, as usual, been kept employed during the half-year under review on the various sections of the company's cables; but, owing to the cables being duplicated, the traffic has in no instance been interrupted.

Monte Video Telephone Company, Limited.

The report for the year ending July 31st, to be presented at the annual general meeting in London on Thursday next, states that the audited statement of accounts shows a net profit of £7,233. This amount, added to the balance of £578 brought forward, leaves £7,811 available, after providing for all working expenses in Monte Video and London, and for loss in exchange, and after writing off amounts for bad debts and depreciation of office furniture. The operating expenses in Monte Video were somewhat heavier, the increase being attributable to a succession of severe storms during the early part of this year, when much damage was done to the plant. At the cost of revenue, however, the property has been maintained in good working order. After placing £1,000 to reserve account, and £500 to the depreciation fund, the directors recommend the payment of a dividend of 4 per cent. on the preference share capital, absorbing £5,600, and leaving £711 to be carried forward.

The Clermont Ferrand Electrical Tramways Company. (Puy-de-Dôme.)

We cull the following details, showing the success of this company, from *L'Industrie Electrique*:—

Receipts for the month of July, 1895	...	48,129.50 fr.
" " " 1894	...	47,248.25 fr.
Increase in favour of 1895	...	881.25 fr.
Receipts since January 1st, 1895	...	200,199.85 fr.
" " " 1894	...	184,450.50 fr.
Increase in favour of 1895	...	15,749 35 fr.
Passengers conveyed in July, 1895	...	338,883
" " " 1894	...	297,777
Increase in favour of 1895	...	41,106
Passengers conveyed since January 1st, 1895		1,554,828
" " " " 1894		1,364,554
Increase in favour of 1895	...	190,274

The City of London Electric Lighting Company, Limited.—The revenue return issued by the secretary for the quarter ended September, 1895, is as follows:—Revenue from sale of current for public lighting, quarter ended September, 1895, £3,182; corresponding quarter last year, £3,141; revenue from sale of current for private lighting, &c., quarter ended September, 1895, £11,600; corresponding quarter last year, £7,676; estimated revenue from other sources, quarter ended September, 1895, £400; corresponding quarter last year, £416; total, quarter ended September, 1895, £15,182; corresponding quarter last year, £11,233; increase, £3,949; equivalent of 8 C.P. lamps connected on September 30th, 1895, 170,827; increase during quarter, 11,577; equivalent of 8 C.P. lamps connected on September 30th, 1894, 114,031; increase during corresponding quarter last year, 13,724.

The Eastern Telegraph Company, Limited.—This company announces the payment by warrants, on November 1st, of interest for the half-year ended October 31st on the 4 per cent. mortgage debenture stock. The transfer books will be closed from October 27th to November 1st, both days inclusive.

The Eastern and South African Telegraph Company, Limited.—This company announces the payment by warrants, on November 1st, 1895, of interest on the 4 per cent. Mauritius subsidy debentures. The transfer books will be closed from October 27th to November 1st, both days inclusive.

The Hove Electric Lighting Company, Limited.—This company, a few days ago, invited applications for 1,874 shares of £5 each, balance of the unallotted share capital of the company. The shares were offered for subscription at the price of £5 5s. per share.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 20th, 1895, **amounted to £927; week ending** October 21st, 1894, £932; decrease, £5; **total receipts for half-year, 1895, £13,701**; corresponding period, 1894, £13,863; decrease, £162.

The Liverpool Overhead Railway Company. The receipts of this railway for the week ending October 20th, 1895, amounted to £1,104; corresponding week last year, £888; increase, £216.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 18th, 1895, **after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,009.**

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue	NAME	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation Oct. 16th.	Closing Quotation, Oct. 23rd.	Business done during week ended Oct. 23rd, 1895. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	4 %	4 %	102 —105	102 —105	103¾	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	£2 2s.	45 — 47 xd	45 — 47 xd	46	45½
2,993,560£	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	£4 4s.	86 — 87 xd	84 — 85 xd	86¾	84
2,993,560£	Do. do. Defd.	Stock	...	...	...	7½ — 7¾	7½ — 7¾	7½	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	6½% §	...	14 — 14½	14 — 14½	14⅜	14⅛
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 - 115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	10%‖ §	... §	2½%	3½ - 4	3½ - 4	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	164 — 168	164 —168	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	2 % §	1½%	1/16 — 1/16	1/16 — 1/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	13 — 14	13 — 14	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½ — 21½	20½ — 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5 xd	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9½ — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	...	4½%	104 —107	104 —107	...	...
60,710	Direct United States Cable, Ltd.	20	3½% §	2⅝% §	2 %	8⅝ — 9¼xd	8⅞ — 9¼xd	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½%	17½ — 17⅝xd	17½ — 17⅝xd	17⅜	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 % §	6 %	18 — 18½xd	18 — 18½xd	18⅛	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	107 —110	107 —110	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	129 —132	129 —132	130½	129½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	18 — 18½xd	18 — 18½xd	18⅜	18
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	103 —107	103 —107	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	104 —107	104 —107	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	128 —131	128 —131	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	103 —107	103 —107	108½	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	104 —107	104 —107	104	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	108 —111	108 —111	108⅜	108½
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	114 —117%	114 —117 %	114	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅞% §	4⅝% §	4½%	10½ — 10⅝	10½ — 10⅝xd	10 5/16	10 3/16
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 %	17 — 17½	17 — 17½xd	17⅛	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝% §	8⅝% §	8⅝%	21¾ — 22¼	21¾ — 22¼	22	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	103 —106	106	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	50 — 53	50 — 53	...	...
130,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	106 —110	106 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	...	...	...	2 — 2¼	2 — 2¼	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 % §	5 %	6⅛ — 6⅜	6⅛ — 6⅜	6 5/16	6¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 16	15 — 16	15 15/16	15⅞
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¼ — 6½	6¼ — 6½	6 7/16	6⅜
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —108	106 —108	107½	106
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	4¼%	1/16 — 1/16	⅛ — ⅜	3/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	109 —112	109 —112	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	nil	5½ — 6½	5½ — 6½xd	5½	...
3,381	Submarine Cables Trust	Cert.	...	...	...	127 —132	127 —132	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2⅜ — 3½	2⅜ — 3½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	92 — 97	92 — 97	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	...	nil	5½ - 6½	5½ - 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	..	.	1½ — 2	1½ — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %		100 —105	100 —105	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	3 %	10¼ — 10⅜	10¼ — 10⅜	10⅝	10½
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½ — 7	6½ — 7	6 13/16	6⅝
33,129	Do. do. do. Def. Ord.	7½	...	...	1 %	3¾ — 4¼	3¾ — 4¼	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	3/8%	¼%	⅜ — 1	7/8 — 1⅛	1¼	1⅜
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10½ — 10⅝	10½ — 10⅝	10⅝	10½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½ — 9½	8½ — 9½	9 3/16	...
80,000£	Do. do 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	111 —114	111 —114	112	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	113 —118	113 —118	...	...
164,300£	Do do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —103	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	4½%	5½ — 5⅝	5½ — 5⅝	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	...	...	...	6⅞ — 7¼	6⅞ — 7¼	7⅛	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	...	116 — 119	116—119	116½	116
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	13 — 14	13 — 14	13½	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15⅝	15½
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	133 —137	133 —137	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8½ — 9½	8½ — 9½	9⅛	9
10,000	Do. do. do. 6% Pref., £6 pd., 40,001—50,000	10	...	...	...	8⅞ — 9¼	8⅞ — 9¼	...	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	5½%	7⅞ — 8⅛	7⅞ — 8⅛	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½%	3 %	11½ — 12	11½ - 10⅜	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	1 %	8½ — 9½	8½ — 9½	9½	9½
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	4½%	6½%	8¼ — 8⅝	8¼ - 8⅝	8⅝	8¼
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9½	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	8½ - 9	8½ — 9	8⅝	8⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Oct. 16th.	Closing Quotation, Oct. 23rd.	Business done during week ended Oct. 23rd, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	6 % §	6 % §	...	1½— 1⅝	1½— 1⅝	1 7/8	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	6 % §	...	2 — 2¼	2 — 2¼	2	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock... ...	Stock	4½%	4½%	...	111 —114	112 —115	114	...
630,000*l*	City and South London Railway	Stock	5/8%	5/8%	1¼%	38 — 40	38 — 40	38	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	1½— 2	1½— 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	...	...	5 %	1¾— 2¼	1¾— 2¼	...	...
100,000	Do. do. do. 4½% Deb. Stock Red....	Stock	...	...	4½%	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	*nil*	5/8— 7/8	5/8— 7/8	3/4	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2 — 2⅛xd	2 — 2⅛	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	3/4— 1	3/4— 1	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	1/8— 1⅛	1/8— 1⅛	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	¼— ⅜	¼— ⅜	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	*nil*	...	6½— 7⅛	6½— 7½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	6 %	14 — 14½	14¼— 14¾	14½	14⅜
3,000	Do. do. do. 7% Pref.	10	...	...	...	15½ — 16½xd	15½— 16½	15⅝	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock		...	...	106 —109	107 —110	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	19 — 20	19 — 20	19⅝	19¼
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	103 —102xd	100 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	1½%	11⅜ —11⅝	11⅜— 11⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	...	5 %	5 %	15 — 15½	15 — 15½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	43 — 45	43 — 45	44¼	43½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	4⅝— 4⅞	4⅝— 4⅞	4 11/16	4⅝

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾ -6¼

Electric Construction Corporation, 6 % Debentures, 98 —102.

House-to-House Company (£5 paid), 4¼—4⅜.

Do. do. 7 % Preference, of £5, 8—8½.

Do. do. 4½% Debentures of £100, 110—112.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 8—8½; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.

Liverpool Electric Supply, £5 (fully paid), 7⅞—8⅛.

London Electric Supply Corporation, £5 Ordinary, ⅜—⅝.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6½—7.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

ELECTRO-METALLURGY AS APPLIED TO SILVER REFINING AND INCIDENTALLY TO OTHER METALS.*

By GEORGE FAUNCE, B.A.S., Superintendent Pennsylvania Lead Company.

How swift is electricity! It hastens on its way with the speed of the lightning. When men began in earnest to investigate its laws, and to make practical application of it to the arts, it seemed as though they became infected sympathetically with this characteristic quality of *hurry*. For the past quarter of a century mankind has been racing tumultuously in the wake of this newest servant of humanity, in the endeavour to subjugate it to 10,000 different uses. Only yesterday it was harnessed to the chariot of human progress, and yet even at the start it is on nearly an even footing with steam. Every day new applications are being made, while old methods and forces are being abandoned.

To-day, a new electrical invention is announced; to-morrow, further progress in the art may render the first useless. Having occasion lately to repair a dynamo that was built about seven years ago, I learned that machines of that type were no longer made. It was hard to recall to mind that such a machine had ever been made; yet, to us, the machine had hardly worn off its novelty.

It is just this rapid evolution and progress that makes it a thankless task to attempt to publish a book, or prepare a lecture, on the practice of one of the electrical arts. Before the ink is fairly dry, new inventions may have made the author's words ancient history. One can only catch and record an instantaneous photograph, as it were, of the present condition of the art, content with the prospect that, before it is exposed to public view, it may be behind the times, and interesting only as a bit of history.

It is needless to state that electricity is a wonderful and mysterious force; any attempt to explain its nature, or to give the theories by which the physicists attempt to explain it, would be outside the province of this lecture. Enough to accept it as a potent factor in our lives. You all know the varied ways in which it manifests its presence. It generates heat, sufficient to weld iron or smelt metals. It lights our houses and streets. It sends messages around the world. It carries our words, and very tones, hundreds of miles. It transports our bodies from place to place with a speed to which there appears to be no limit. It can do subtler things than these. At its magic touch chemical affinities are overcome, and substances are split up into their elements. Thus it manifests itself in the form of heat, light, motion, chemical action, while it is said to aid the growth of plants, attempting to rival the sun in its life-giving powers.

This much by way of prelude. I will now enter upon the subject of the evening's lecture, which is the study of that one, among the various manifestations of electricity, on which the art of electro-metallurgy depends, namely, that force which causes the decomposition and recomposition of chemical compounds. This force is named *electro-chemical force.*

Metallurgy is the art of obtaining metals from their ores and includes the refining and parting of metals, as well as the smelting of ores; in fact, all processes by which the metals are isolated or set free from accompanying impurities.

Electro-metallurgy, therefore, in its strictest sense, should be defined as the art of obtaining metals from their ores, by the agency of the electric current. Unfortunately, until recently, the sole practical application of electricity to the isolation of metals has been in the separation and deposition of certain metals, from aqueous solutions of their salts, upon a prepared surface, as in the processes of electro-

* A lecture delivered before the Franklin Institute.

plating and electrotyping. In these processes the finish of the plated articles, or the quality of the deposit, is of the first importance, and not the gaining of the metal.

The term electro-metallurgy, to most persons, is now synonymous with this kind of deposition. It would be better to call these processes *electro-deposition*, since the proper deposition of the desired metal on the surface of the article treated is the sole object aimed at; and to reserve the term electro-metallurgy for its correct signification as the art of recovering metals from their ores, and refining them by electricity. In the first case, the nature and form of the deposit is everything. In the second case, these are secondary considerations, while the great desideratum is quantity and purity of deposit.

Historical Sketch.—One of the commonest and simplest forms of electro-deposition is shown when one metal is coated with another by simple immersion in a solution of a salt of the latter. For example, iron dipped into a solution of copper becomes coated with copper, while copper receives a deposit of silver when dipped in a solution of silver. Zinc, or aluminium, precipitates lead from its solutions, while lead in turn throws bismuth out of its solutions. The fact of the deposition of copper from its solution by iron is mentioned as early as the fifth century. Palissy, the potter, in the sixteenth century, describes the method of coating copper and iron with silver by immersion in silver solution. Sulzer, in 1752, noticed a taste like that of green vitriol when silver and lead in contact were placed on the tongue.

In 1790, two Dutch physicists decomposed water by means of electrical sparks (obtained by friction). In 1799, Volta made his famous discovery of the production of an electrical current by chemical action; and shortly after produced his "crown of cups," by means of which a continuous current could be produced.

All the curious facts known and noted up to this date had remained simply curiosities in the realm of science, and no practical application of them, so far as we know, had been made. From this time, however (that is, no longer ago than the beginning of the present century), investigators began to record results with increasing frequency, although two score years more were destined to pass before any of their discoveries should bear fruit in actual industrial processes.

I will rehearse some of the discoveries which bear directly on our subject.

In 1800, water was first decomposed by the voltaic current. In 1801, it was noticed that if silver were used as a negative pole in a solution of copper, the silver received a coat of copper which would stand burnishing. During the next few years various observers noticed the liberation of the constituents of various salts at the two poles of the batteries, and Brugnatelli gilded two silver medals, by making them negative poles in a gold solution. Sir Humphrey Davy, in 1807, deposited metallic potassium on platinum by means of a powerful current of 274 cells, which was passed through moistened caustic potash. In 1831, Faraday discovered magneto-electricity, on which discovery depends the principle of all the dynamo machines of to-day. In 1834, he formulated his law of electro-chemical equivalents, which will be referred to later.

In 1836, the Daniell cell for generating electricity was invented. It was the first two-liquid cell, and gave a very constant current. As it is the type of nearly all the batteries now in use, and affords an instructive illustration of the process of electro-deposition, it will be well to describe its construction and action. It consists of an external vessel containing a cylinder of zinc. Inside of the cylinder of zinc is a porous earthenware vessel, and inside of this again is a strip of copper. The inner porous vessel is filled with a solution of sulphate of copper immersing the copper strip. In the external vessel, and immersing the zinc cylinder, is dilute sulphuric acid. The acid slowly dissolves the zinc, forming sulphate of zinc and liberating hydrogen. The hydrogen passes through the porous clay vessel, displaces the copper of the sulphate of copper, thus forming sulphuric acid. The copper, which is displaced from the sulphate, is deposited on the strip of copper which forms the negative pole of the battery.

From 1837 to 1840, electro-deposition, in the form of electrotyping and electroplating, was brought prominently into notice, and began to be used practically on the commercial scale. For several years the deposition was performed exclusively by currents generated with batteries, but in 1842 Woolrich took out a patent for the first magneto-electric machine for generating currents for electro-deposition. From that date, until 1866, no new principles in electro-deposition were discovered, but some progress was made in the improvement of machines, solutions, and other details. In 1866 Elkington, in England, obtained a patent for refining copper by electricity, and this date marks the beginning of the application of the electric current to electro-metallurgy proper. The electrolytic copper refining industry has assumed immense proportions, and following hard upon it have come processes for refining silver-lead, for smelting aluminium and aluminium alloys, as well as numerous processes for extracting metals directly from their ores without the intervention of heat derived from fuel.

(To be continued.)

THE CONTROL OF TRANSFORMER LOSSES ON CONVERTING SYSTEMS OF ELECTRICAL SUPPLY.

By JAMES WHITCHER, A.I.E.E.

The editors of this Journal having, in a note to some correspondence of mine last year, courteously expressed a wish for a further explanation of my system of controlling the transformer losses on converting systems of electrical distribution, I shall here endeavour to satisfy that wish; and I trust that the following paper will set forth the salient points of my system fully and clearly, and be as well a useful survey of this particular region of electrotechnics, as it maps out to one who has been prospecting over it.

In the absence of any means of storage, the true test of a system of energy distribution, working on a fluctuating load, is its cyclic efficiency, *i.e.*, its efficiency averaged over a period of time sufficing for the passage of the load changes through one complete cycle. For, on a supply system characterised, as is more general, by much inconstancy and deficiency of useful load, the various sources of distributing loss have a relative importance among themselves, and influence upon the cyclic efficiency, very different to what is the case with a uniform load. It is not then the rates of waste alone that determine the efficiency, but their proportional, or want of it, to the load as well. In many practical cases the latter is by far the more dominant factor.

Of course, if all the losses were simply proportional to the load, the efficiency of distribution on a fluctuating load would be identical with that on a uniform load. But none of them have so simple a relation to the useful output. On simple direct systems, for instance, they consist wholly of ohmic loss in the mains; this is in terms of the square of the load, and the efficiency is actually higher on a poor load factor than a better one. But in converting systems, apparatus is introduced into the distributing mechanism in which there are losses that have an influence on the cyclic efficiency quite at the opposite end of the scale. Whether for series or parallel distribution, there is a set of losses in the transforming plant which stands entirely independent of the load. Hence the percentage waste varies inversely as the load; and on a long continuance of defective output, the ultimate efficiency may suffer serious depreciation.

It is this particular set of converting losses that it is sought to control; they are constant wastes of the distribution, and the object of the control is, of course, to break down their independence, and make them in some degree proportional to the load. The remaining transformer wastes, which, together with those in the mains, may be grouped under the heading of load losses, have no need of control; for being in every case proportional to higher powers of the load than unity, they are already under an ideal regulation.

It is then with the constant losses, peculiar as they are to converting systems of distribution, that we have to deal. Submitted to as the price of what seems primarily an immense advance in economic efficiency, they prove a most exacting tax in practice, sufficient to negative, in some cases, the whole of the apparent advance. In parallel systems with motor-dynamos, they comprise the losses in friction, field excitation, and by hysteresis and eddy currents in the arma-

tures. With alternating currents they consist merely of the hysteresis and eddy current wastes in the transformers. In series systems there is simply a reversal of class; what were load losses in parallel systems—the copper wastes—become constant losses in series systems, and *vice versâ*. This leads to the note that in a system combining the series and parallel characteristics, there would be no constant losses. This, in fact, is what a certain case of my system, in a measure, achieves.

It will be well to state clearly, by an instance or two, the condition of things that makes control necessary. Take the case of alternating currents as at present the more important. Here transforming plant may, at no excessive cost or difficulty, be designed to show a full load efficiency of 97 per cent., having, say, a constant loss of 1½ per cent., and a load or copper loss of 1½ per cent. On a load factor of 10, or the equivalence of 2·4 hours full load per diem, the constant loss would total to 15 per cent. of the output, and the copper loss to not much more than 1 per cent., making the cyclic efficiency 84 per cent. With a load factor of 12, it is 81 per cent.; of 16—75 per cent., and of 20—69 per cent. The amount of energy lost annually in constant losses is, of course, a fixed quantity; in the case given it is 131·4 units per kilowatt capacity of transforming plant.

With continuous current transformers, the constant losses being a larger percentage, the effect is yet more marked. Putting the constant losses at 5 per cent., the cyclic efficiency at a load factor of 10 is less than 50 per cent. The annual waste in constant loss is 438 units per kilowatt capacity of plant.

An obvious method of reducing these losses is to regulate the proportion of plant in action at any time, so that it shall not be much more than sufficient to meet the load. Stated generally, the methods of control can operate only through what may be called the "activity" of the plant; to which the losses are proportional. By the term activity is meant the maximum effective capacity, in watts, for a given percentage drop of potential. Thus a transformer working at 2,000 volts has four times the activity it would have at 1,000 volts. It follows that the total activity of a transforming plant may be influenced in two ways—by varying the number of members of the plant in action, or by varying the individual activity of the members by changing their working potential.

The following instance will clearly exhibit the effects of the two methods. Take an alternating current transforming plant with a capacity of 20,000 watts, divided into four members of 5,000 watts each. Assume the constant loss in each to be 2 per cent., or at the rate of 100 watts, and the copper loss at full load to be the same. The table below shows how the efficiency is influenced by several methods of grouping the members for various values of the load. Note that putting two members in series halves the E.M.F. on each, and therefore the induction, and in consequence the constant losses, are reduced to about one-third.

TABLE OF EFFICIENCIES OF AN ALTERNATING CURRENT TRANSFORMER PLANT OF FOUR MEMBERS, EACH 5,000 WATTS SIZE, FOR VARIOUS GROUPINGS AND LOADS.

Load.	Grouping.	Activity.	Constant losses.	Load losses.	Total losses.
20,000	4 parallel	20,000	400	400	800
15,000	4 „	20,000	400	225	625
„	3 „	15,000	300	300	600
„	2 parallel, 2 series ...	12,500	266	400	666
12,500	4 parallel	20,000	400	156	556
„	3 „	15,000	300	208	508
„	2 parallel, 2 series ...	12,500	266	250	516
10,000	4 parallel	20,000	400	100	500
„	3 „	15,000	300	133	433
„	2 „	10,000	200	200	400
„	2 parallel, 2 series ...	12,500	266	177	443
„	2 series, 2 series ...	5,000	132	400	532
5,000	4 parallel	20,000	400	25	425
„	3 „	15,000	300	33	333
„	2 „	10,000	200	50	250
„	1 „	5,000	100	100	200
„	2 series, 2 series ...	5,000	132	100	232
2,500	1 parallel	5,000	100	25	125
„	2 series	2,500	66	50	116
„	3 „	1,666	52	75	127
„	2 in series with 2 parallel	2,000	70	63	133

The grouping is denoted thus:—"Four parallel" means four members connected to the mains in parallel; "two parallel, two series," means two in parallel and one series chain of two; "two series, two series," means two series chains of two; and so on. All the quantities are in watts.

It must not be forgotten that these results apply only to the one ratio between the constant and full load losses. Here they are equal; and it may be seen, firstly, that there is no great gain to be made by any regulation of the transformer activity until the load falls to nearly one-half its maximum; secondly, that the very simplest mode of regulating the activity—*i.e.*, by cutting members out of circuit as they become superfluous—is, in this particular case, the better. Generally, these conclusions apply with greater force for cases of the above ratio ranging from unity; while, for higher ratios—when the transformers have excess of iron loss—they become less applicable. A notable point apparent from the table is, that the best efficiencies occur when the constant and load losses are equal.

There is a well-known method of controlling the activity of a single transformer by the use of sectional windings, arranged for sections to work either in parallel or series with each other. An advantage of this is, that the transformer being large, a high efficiency is secured at a low first cost. But, from above deductions, unless the iron wastes of the transformer are of excessive proportion, the method is not so effective as putting sections or members out of action altogether. For the saving of iron loss by the lowering of the induction is gained at the expense of a larger relative increase of load losses. Thus, with two sections, while the activity is reduced to one-fourth, the constant loss is diminished only to one-third of the original values. With three sections, the activity is reduced to one-ninth, and the constant loss to about one-sixth, by changing the sections from parallel to series grouping. The large reduction of the activity resulting from the change requires that this shall take place at low loads, making the method a suitable one for using automatic switches, which require a wide variation of load to actuate them.

A useful but crude control of transformer losses may be obtained by the use of these sectional transformers, with switches arranged so that the change-overs can be made by an attendant going the round of them at regular times.

The best regulation is, of course, that to be obtained in large sub-stations with an attendant. If the plant be suitably designed, and the attendant up to his work, a very high cyclic efficiency should here be attained; and both design and attendance are simple enough, since series working is not requisite.

Irrespective of the way in which the activity of the converting plant is varied—whether by cutting out members, or by varying their individual activity—there are several practical modes of performing the operation. Some of these have been mentioned, but they are all enumerated in the following list:—

1. Large sub-stations, with converting plant divided into units of convenient and, for simplicity's sake, uniform size, though efficiency and economy of capital may be better served by the use of a gradated set of sizes, as for instance, units ·1, ·2, ·3 and ·4 of the total station capacity. Here, with only four members, 10 steps or changes of activity are possible. Each sub-station must be complete with the necessary switchboards and instruments. The primary and secondary switches of each transformer should be coupled. In the nature of things these large sub-stations cannot come into extensive use—at least until electric lighting becomes much more general and dense than at present. Then it will not be for this one purpose alone; to justify the expenditure on them, the sub-stations must have a wider range of utility as general distributing and regulating centres.

2. Small sub-stations, or street boxes, each with a group of transformers, or one with sectional coils, and coupled primary and secondary switches, placed so that they can be operated by an attendant going the round with a key. He would, of course, receive his instructions for each journey from the central station engineer, on whose judgment, in decreeing the times of change-over, the safe and successful operation of the method depends.

3. Large or small sub-stations, with grouped or sectional transformers, and primary and secondary switches arranged to be operated by an automatic mechanism, brought into

action by variations in the load. A variety of contrivances have been devised for this purpose; but in general they comprise a relay in the secondary circuit, which, as the load passes a certain value up or down, temporarily closes a circuit through a motor, magnet, or solenoid, which throws over the switch. The more usually, a motor, rotary or reciprocating, is necessary to provide the power requisite to work the switch with ease and certainty. In some cases the accumulated force of a falling weight is used, the weight being replaced by a motor mechanism, or, in an imperfectly automatic system, by hand, ready for the next change. A multiple grade of changes of activity may be secured by multiplying the number and complexity of the relays and switches; but in view of the excessive complication, it would be never advisable. Inspection of an average load curve shows that the advantage to be gained by succeeding steps is small compared with that secured by the first, making it almost superfluous to have more than one judiciously selected point of change-over in the half cycle of loads.

4. Large or small sub-stations, with transforming plant controlled by primary and secondary switches, which can be operated by mechanism, actuated by energy transmitted from the central station. Dismissing the use of any form of energy but electricity as inept, it is clear that at least one extra conductor must be employed. This as a lead, one of the mains being utilised for the return. However, the pilot wires used to indicate the feeding point pressure at the station are generally available. The motor mechanism of the switch can be put in this circuit, being constructed so that an impulse of current, such as the pilot wires can carry with safety, will perform the required operation. If pressure is always on the mains, simply short-circuiting the station end of the pilot wires will put the switch motor in action. Here is a very convenient method, one under the direct control of the station engineer, in so far as the switch and motor mechanism prove reliable. Moreover, it admits of simple effective design, and is notably capable of a multiple grade of operations. With the motor, a ratchet one, similar in action to that of the A.B.C. telegraph instrument, several different commutations, each at will, can be performed from the distant station by means of suitably ordered numbers of impulses. Mr. T. Parker has made effective use of this method at Oxford.

(To be continued.)

FIRES OF ELECTRICAL ORIGIN.*

By WILLIAM H. MERRILL, Jun.

During the last two years the electrical inspectors of the United States have co-operated in compiling accounts of the circumstances leading up to all electrical fires and burnouts which have come under their observation. These accounts have been condensed and issued in the form of quarterly reports, so that all of the inspectors could receive the benefit of knowing what causes were producing electrical fires outside of their own territories. We have thus far on record accounts of nearly 1,000 such electrical fires. These do not, of course, represent the total electrical fire waste, because there are only about 40 electrical inspection departments in the country, and because so many fires destroy all evidences of their origin. Incomplete as they are, they nevertheless have the advantage of being wholly accurate, and of covering portions of the country having different climatic conditions, and where somewhat different practices are prevalent in the manner of installing electrical systems. The aim in obtaining these accounts has been to secure an approximate comparison of the fires due to different electrical causes, and not to receive accurate accounts of losses. The detailed accounts given of fires, in which no loss resulted, have proven of greater instructive interest than the ones in which losses were paid, because the exact cause and conditions could be more accurately determined. Fires resulting in large losses generally destroy evidences of the cause, and but few large fires are included in the reports. Thus, for the first year during which the reports were collected, the total loss reported amounted to only $1,415,610.25. This, of course, gives no idea of the annual electrical fire waste, and can only serve as a known fraction upon which to base an estimate of the total.

It is not, however, to the loss account, but rather to the exact and specific causes of these fires that inquiry should be made, for it is there that the remedy can be found.

A comparison of causes among 815 electrical fires published in the first eight reports, shows that 113, or over one-seventh of these losses, were caused by the crossing of telephone, telegraph and similar wires with trolley or electric light wires. Heavy current flows, established by such accidents through telephones, telegraph instruments and switchboards, always result in damage to these devices, and oftentimes in their destruction, and the communication of fire from them to surrounding combustible material. The total loss due to these 113 fires was $324,957.50, which is a pretty large sum to charge to accidents which must be considered preventable. Assuming, then, that a large percentage of electrical fires are caused in this manner, let us look for the remedy.

Removing conducting wires from exposure to the elements is the only absolutely certain way of overcoming all of the danger threatened by aerial wires, as it is the only cure which strikes at the root of the evil. By this means the chances of contact between wires of different systems is reduced to a minimum, and the hazard from lightning entirely eliminated. The cry, "bury the wires," has been successfully raised in many of the larger cities of the country, and laws and ordinances have been enacted requiring electric conductors of all or of certain classes to be placed underground.

It would seem that the experiences of the larger cities in this matter would serve as useful examples to the smaller ones where electric equipments are growing at all extensive. Almost without exception the movement to place wires underground has come after the poles and roof structure of a city have grown to such numbers as to mar the appearance of the streets. Then, after a great amount of money has been spent in overhead construction, the electric companies have been called upon to tear it all down, and go to the additional expense of installing underground work. It will be seen that the entire original outlay could have been saved by using underground systems of distribution originally. The way in which history is repeating itself in different parts of the country in this matter ought to serve as a useful lesson to all managers of electrical enterprises whose business depends upon aerial wires, and the manner in which losses from this cause are accumulating, ought to serve as a sufficient reason for every underwriter to miss no opportunity to oppose outside overhead electrical construction work, or to call attention to the advantages to be gained from a fire, life or æsthetic standpoint, by running electric wires underground. No great technical knowledge is needed to enable one to advance convincing arguments on the disadvantage of aerial wires, and it will often be found that comparatively little influence is necessary to start such a movement along the road to success. Many of the cities of the West offer fruitful fields for work of this kind, and a little of the time of every field man could be profitably spent in agitating the subject when opportunities present themselves. In country districts, where the cost of underground electrical construction would be prohibitive, care can be exercised in providing guard wires, and in installing protective devices where wires enter buildings, but these are, perhaps, matters to be treated by the electrical companies and the district inspector rather than the field man.

It is unfortunate that trolley companies have installed their roads in so many places without any regard to the telephone or telegraph wires running above them, and that telephone companies have been so backward in designing and installing efficient devices to place in their circuits for the protection of their instruments. Like in a great many other admirable and perhaps necessary things, the item of expense has held back improvements of this kind, though the outlook for obtaining respect for other people's rights in this particular from these corporations becomes more hopeful as accidents to life and losses by fire, due to this negligence on their part, become more numerous and apparent. Such occurrences as those referred to in the following reports, for instance, tend occasionally to direct attention to the subject :—

* Read before the Fire Underwriters' Association of the Northwest, Chicago, September 25th, 1895.

Fire No. 712 :—Cross between telephone and trolley wire. Pole on the trolley car raised the trolley wire, so that it came in contact with a telephone cable stretched above it. Forty-two of the 75 telephones connected to the exchange were burned out and the switchboard ruined.

Fire No. 479 :—"We had a severe storm here on the 26th, which played havoc with overhead wires on the streets. A large number of the telephone company's new distributing poles, 90 feet in height and 18 inches in diameter, were broken and fell, letting down wires in all directions. Together with this, nearly all overhead wires were disabled and crossed with electric light and trolley wires. The trolley railways were interrupted for several hours; 10 horses were killed on the streets; hundreds of telephone, telegraph, and fire alarm signal boxes were burned out. Singular to say, only two fire losses were reported. The origin of one of the fires was plain to be observed, and is suggestive. A high tension current was conducted over a burglar alarm wire into a building, and at the point where the wire was grounded on the gas-pipe, the current pierced a hole in the pipe, and ignited the escaping gas, which set fire to the surrounding woodwork. Damage about $50."

Next in importance to aerial wires comes wooden base devices, that is, electrical switches, cut-outs, and uninsulated current carrying strips, bars and connections of all kinds which are mounted directly on woodwork, instead of on porcelain, slate, marble, or some such non-combustible material.

Wood used for bases for such devices is responsible for 67, or one-twelfth of the 815 fires given in the first eight reports, and for a total loss of $116,027. Under this heading is not included wooden cleats or similar supports which come in contact with the insulated covering of a wire. By wooden base devices are meant only such as have bare current carrying parts mounted directly on woodwork.

Burnouts from this cause are very numerous, and I know the reports show but a very small fraction of the total troubles from this cause, as hundreds of them result without loss. Exactly why it was ever supposed wood was a proper material for mounting electrical contact devices on I cannot explain. Fortunately to-day the manufacturers have nearly all learned a lesson; but unfortunately for the insurance interests, they sold a great amount of material before finding it out, and they didn't give a 10 year guarantee with any of it.

On account of this mistake of the electrical manufacturer, the insurance field-man must remember that where risks are equipped with wooden base cut-outs, switches, hanger boards for arc lamps, rosettes and similar appliances, that a fire will result just as soon as a loose connection is established to generate heat enough to ignite the wood. And so the record runs through specific causes, such as sparks from arc lamps, heating effects of incandescent lamps, and overheating of wooden encased resistance devices, and through general causes due to defective systems, such as the operation of lamps and motors, by current supplied from trolley wires, and the many troubles which lead up to breakdowns in transformers, and result in conveying pressures of 1,000 volts on to interior wiring systems designed for 50 or 100 volts. The total cost of these happenings to the insurance companies may be $3,000,000, or may be $5,000,000 annually. We have proved that it is over $1,500,000, and we know that whatever the total may be it is altogether too large, and that greater effort should be made to prevent it by the electrical manufacturers, the lighting companies, architects, municipal authorities, the public generally and the insurance companies.

We have recently found an easy and effectual way of enforcing complaints against the manufacturer by the formation of the Electrical Bureau of the National Board, under whose direction defects discovered in any electrical device are portrayed in pictures and words, and the reports distributed to the various insurance associations and companies of the country, and other people interested. This always leads to improvement in the manufactured article. The lighting companies always will be troublesome, because there are so many of them so widely distributed, because they all wish to sell current, and because they find it easier to obtain customers if the cost of installation is cheap. There are a few exceptions to this rule among companies supplying current who do not do construction work, but many of them, like the majority of the electrical contractors of the country, do not consider good practices, or the safeguards necessary to prevent fire other than as decided hindrances, to what they are pleased to consider their legitimate business.

The architects, from necessity, are becoming more or less informed on electrical matters, and some of them have the good sense to employ specialists in this field. Slowly but surely municipal and state authorities are seeing the necessity of exercising supervision over electrical installations, and the number of municipal electrical departments increases every year. The people generally, or such of them as secure a common education, will eventually, of course, take this matter into their own hands, and of their own knowledge prevent the frauds perpetrated by electrical contractors, and the installation of a good deal of unsafe wiring.

Electricity is becoming so common to our everyday life, that the schools must teach its laws, and therein lies the true solution of the problem. I am afraid there will never be much to hope for from people like our friend whose experience is recounted in the report on fire No. 701. Upon retiring to his room in a hotel he attempted, through lack of familiarity with the apparatus, to blow out an incandescent electric light. Failing in this he wrapped a towel around the lamp and went to bed. Some time in the night the heat from the lamp ignited the towel, and the gentleman was taken from the room by the firemen in an unconscious condition, having been partially suffocated by the smoke.

To those who live in cities, however, electricity is becoming daily more common, and two or three generations hence we may hope to see the occupants of some of our mercantile buildings intelligently doing their own wiring.

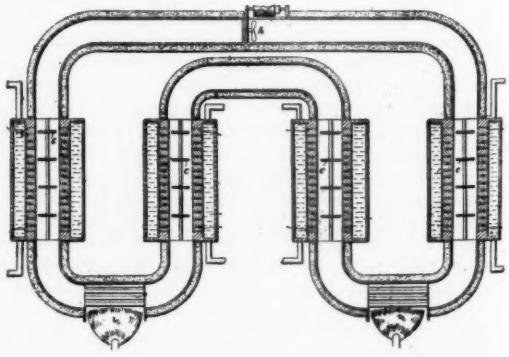
The insurance companies have done a great deal toward informing the public on electrical matters, and it is certain that they can economically do more with beneficial results. A little knowledge is not always a dangerous thing, and each one of you could perhaps pick up something in this line which it would be well to tell your neighbour, especially if he is insured in your company, and is using electricity.

If everyone could only know and appreciate the facts that wires ought to be underground, that wooden base electrical devices are poor things to have around the house, that arc lamps give off sparks, that incandescent lamps get hot, that wires should be kept free from grounded pipes, and the other useful little lessons that these electrical fires teach us, how much better your loss accounts would appear.

The insurance men throughout the great Northwest are certainly competent to learn and repeat some of these mottos, and I am certain that if they all would attempt it, a great amount of benefit must ensue.

HEATING APPARATUS FOR THERMO-ELECTRIC GENERATORS.

The inventor of the Cox thermo-electric generator, which was described in the Electrical Review, Vol. 36, p. 612, describes in the *Electrical Engineer* of New York a new method of distributing the heat uniformly to a number of generators working together.



The central flues of all the generators are connected together by pipes, so as to form parts of one endless conduit as shown in the illustration.

A continuous circulation of the air is maintained in this channel by a small fan, *h*, turned by an external motor. The air is heated by passing through a series of tubes heated externally by gas jets or other source of heat. Inside the flues of the generators are placed deflectors to throw the hot air against the ends of the thermo-electric couples fixed in the walls.

Among the advantages realised by this arrangement, Mr. Cox considers that a uniform E.M.F. can be obtained from all the generators worked together in this way, owing to the uniformity in the temperature of the air circulating through each. He also considers that the heat energy is very materially conserved, and that a large portion of the heat energy hitherto wasted is utilised.

the proposals of various companies with their estimates for distributions of 10,000 and 20,000 lamps, or about 600 and 1,200 kilowatts.

It will be observed that the cost of a distribution of electrical energy for 10,000 lamps (or 600 kw. at 60 watts per lamp) is estimated at from 1,115,570 francs (simple alternating currents) to 2,500,442 francs (continuous currents with three wires); for a distribution of 20,000 lamps (or about 1,200 kw.) the expenses of establishment may vary from 1,645,958 francs (simple alternating currents) to 2,197,410 francs (continuous currents with three wires.) The *Elektricitäts Aktien Gesellschaft*, formerly *Schuckert & Co.*, submitted a plan of distribution by polyphased currents at a price lower than the distribution by continuous currents with three

Companies.	Description of plans.	Total expenses of installation in francs (system for 20,000 lamps).			Remarks.
		Distribution for 10,000 lamps.	Distribution for 20,000 lamps.	Single system.	
Allgemeine Elektricitäts Gesellschaft	Continuous current distribution—three-wire system with neutral wire of naked copper.	1,954,213	2,197,410	1,139,443	If the neutral wire should not be of naked copper the expenses would be increased by 123,450 francs.
Ditto	Polyphased current distribution with primary and secondary systems.	1,586,332	1,848,046	802,425	System for the full load, 851,805 francs.
Aktien Gesellschaft Helios ...	Distribution with simple alternating currents with primary system and 300 transformers.	1,115,570	1,728,300	454,205	The transformers are included in the expenses.
Ditto	Continuous current distribution with three wires.	2,080,152	1,728,300	1,245,167	
Elektricitäts Aktien-Gesellschaft (formerly Schuckert & Co.)	Continuous current distribution with three wires, neutral wire insulated.	1,719,658	2,046,430	985,871	
Ditto	Continuous current distribution with three wires, neutral wire of naked copper.	1.554,358	1,851,007	820,942	
Ditto	Distribution with simple alternating currents with primary and secondary systems and transformers.	1,220,056	1,615,958	630,057	System for the full load, 736,051 francs.
Ditto	Same distribution with primary system.	1,256,722	1,779,902	647,645	System for the full load, 872,149 francs.
Ditto	Distribution with polyphased currents with primary and secondary systems.	1,366,961	1,827,430	771,920	System for the full load, 910,814 francs.
Elektricitäts Aktien-Gesellschaft (formerly Lahmeyer & Co.)	Same distribution	1,604,850	...	1,021,672	
Siemens & Halske	Polyphased current distribution with primary and secondary systems 73·6 kiloms. overhead.	1,201,785	...	745,530	
Ditto	Same distribution, with cables ...	1,317,828	...	861,575	
Naglo Bros.	Continuous current distribution with three wires.	2,500,442	...	2,028,267	The system is calculated for a loss of 5 per cent. in the feeders.
Ditto	Same distribution	1,534,442	...	1,047,771	The system is calculated for a loss of 13 per cent. in the feeders.
Ditto	Polyphased current distribution.	1,143,782	...	725,045	

These anticipations appear, however, to be somewhat exaggerated. The failure of the hot air engine has chiefly been due to the fact that metallic vessels containing air do not last for any time when heated externally by a furnace to a high temperature. Mr. Cox, we have no doubt, will encounter the same difficulties with his heater for thermo-generators. It is difficult also to see where the economy in heating comes in. The direct application of the hot furnace gases to the heat absorbing surface of the generators must surely be more economical than a secondary application through the medium of circulating air.

INSTALLATION EXPENSES FOR THE ESTABLISHMENT OF A CENTRAL STATION AT DORTMUND.*

The *Frankfurter Zeitung* has published the results of the estimates submitted for the establishment of a central station at Dortmund in Germany. The accompanying table shows

* *L'Industrie Electrique.*

wires (1,366,961 francs instead of 1,719,658 francs), but higher than the distribution by simple alternating currents (1,220,056 francs). J. L.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled specially for this journal by* Messrs. W. P. Thompson and Co., *Electrical Patent Agents*, 31, *High Holborn, London, and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.*]

NEW PATENTS.—1895.

18,711. "Improvements in and relating to the application and working of motors for propelling and controlling the travelling of railway, tramway, and other vehicles." J. Murris. Dated October 7th.

18,725. "Improvements in electric cables." G. H. Nisbett. Dated October 7th.

18,726. "Improvements in electric cables." J. A. L. Dearlove and G. H. Nisbett. Dated October 7th.

18,769. "Improvements in or relating to the transmission of electricity and sound, and a means of reducing electrical resistance in the air, earth or sea." R. J. Crowley. Dated October 7th.

18,822. "Improvements in mounting electric incandescence lamps for orchestral reading and like purposes." W. Crawshaw and H. Bevis. Dated October 8th.

18,868. "Improvements in electric velocipedes." H. W. Libbey. Dated October 8th.

18,870. "Improvements relating to electromotors and transformers." W. Langdon-Davies and The Alternate Current Electro Motor Syndicate, Limited. Dated October 8th.

18,875. "Improvements in concentric electric cables." H. Edmunds. Dated October 8th.

18,911. "Improvement in electrical hanging bell push." H. Benest. Dated October 9th.

18,912. "Illuminated decoration by electric light in plaster ornaments." C. Gillard. Dated October 9th.

18,931. "Improvements in prepayment apparatus for attachment to gas, electricity, or other fluid meters." W. Webber. [Date applied for under Patents, &c., Act, 1883, Sec. 103, April 16th, 1895, being date of application in United States.] Dated October 9th.

18,935. "Improvements in apparatus employed in regulating electromotive force in alternating current circuits for theatre lighting or other useful purposes." I. Probert and E. F. Moy. Dated October 9th.

18,944. "An improved method of insulating electric conductors." G. Sutton and R. J. Hatton. Dated October 9th.

19,002. "An improved wheel trolley for single-wire system of electric traction." H. Brecknell. Dated October 10th.

19,027. "Improvements in electric metering apparatus." W. L. Wise. (Communicated by W. S. Barstow, United States.) Dated October 10th.

19,056. "Improved means and apparatus for testing specific gravity of liquids, specially applicable for testing battery acids." C. Pollak. Dated October 10th.

19,067. "Improvements in electric signalling apparatus." F. Warren. Dated October 10th.

19,104. "An improved method of making and applying electric rail-bonds." F. E. Buxton. [Date applied for under Patents, &c., Act, 1883, Sec. 103, April 15th, 1895, being date of application in United States.] Dated October 11th. (*Complete.*)

19,130. "New or improved chemical substance and the application thereof to industrial purposes, such as rubber, gutta-percha, or celluloid substitutes, insulations of electrical conductors, coverings for ships' bottoms, or wall and floor coverings." P. C. D. Castle. Dated October 11th.

19,177. "New or improved electric lantern for velocipedes." H. O. Johnsen. Dated October 12th. (*Complete.*)

19,199. "Improvements in dynamos." A. G. New and A. J. Mayne. Dated October 12th.

19,204. "Improvements relating to electric signalling in open ircuits." J. R. Gibson. Dated October 12th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1894.

5,269. "Improvements in mechanism for forming battery plates." C. J. Reed, 441, Chestnut Street, Philadelphia, Pa., U.S.A. Dated September 12th. This is a form of roller mill for forming battery plates from a sheet or strip of metal, consisting of means for rolling grooves in the material and additional means for forming stiffening ribs at the ends of each plate, in combination with means for cutting out a section of the material between each pair of plates as rolled, whereby lugs or ears are made integral with the plate. 10 claims.

10,445. "Improvements in apparatus for electrolysis of alkali salts with quicksilver as cathode." H. C. F. Stormer, 5, Zetlitzgade, Christiania. Dated November 26th. Relates to apparatus in which the amalgam formed of the quicksilver by contact with the electrolyte shall be prevented from taking up oxygen from the water. In one form the quicksilver is contained in troughs which are suspended by a frame which receives a vertical shaking motion. The amalgam is distributed through the quicksilver by the shaking and runs off in a concentrated form from the bottom trough. Outside the apparatus the amalgam is freed from the alkali metal, and the quicksilver used over again. 2 claims.

1895.

4,019. "An improvement in electric apparatus for engine room signalling and like purposes." S. M. Eardley-Wilmot, W. T. W. Thackeray, S. Hoare, and K. R. Mackenzie. Dated February 25th. Relates to improvements in apparatus described in Specification No. 8,302 of 1888. A bell is provided near the transmitter and a bell in the engine room, which keep ringing when a signal is transmitted until the order is attended to. When this is done a cam on the weigh shaft or other reciprocating part by which the engine valves are worked, operates on spring-controlled plungers to open the bell circuit, and stops both bells. 1 claim.

4,255. "A novel apparatus, whereby a battery of great internal resistance is rendered capable of generating an induction current in coils of low internal resistance." G. Laura, 41, Via Cavour, Turin, Italy. Dated February 27th. The apparatus comprises two plates of comparatively large area, coiled in a spiral without touching and inserted in a vessel filled with concentrated sulphuric acid. Leads are soldered to the plates, and the whole is then put in derivation with the circuit which it is desired to strengthen. 1 claim.

4,697. "Improved electric signalling apparatus for railways." G. A. Lyncker, 5, Lothstrasse, and A. Schropp, 26, Schwindstrasse, Munich, Germany. Dated March 5th. Rail contacts are provided at each signal box or watchman's post which are operated by each train as it passes, so that a bell rings both at the post which is being passed and also the post previously passed. The watchmen at their posts being thus notified as each train passes, are warned when two trains by chance run into the same section of a track at the same time, and can take steps to avert a collision. Similar devices are described, to be operated by a train, to give notice of its approach to level crossings and the like. 2 claims.

4,873. "Improvements in or connection with electrical insulating materials." T. P. Wiggins and G. H. Wiggins (trading as F. Wiggins & Sons), 102, Minories, London. Dated March 7th. Relates to a built-up plate of mica, the breaking away, sliding, or scaling of its laminæ transversely being prevented. Pieces of mica of required thickness and convenient size are taken, the sides of which are serrated or otherwise formed to enable the sides of one piece to interlock with the sides of the other pieces. These pieces are fitted together to form a continuous sheet, and are so disposed that the serrated sides are arranged transversely of the finished sheet. The ends shown are cut square, but this need not be the case. 3 claims.

5,133. "Improvements in railway signals." M. P. Hall, 80, Broadway, New York, U.S.A. Dated March 11th. Claim 1. In a railway signal, the combination of a casing having an aperture in the front for a night signal, and two registering apertures in front and back for a day signal arranged to present a stationary disc to give one positive character of indication, a day signal disc and a separate night signal disc arranged to move in and out of register with their apertures, the day signal disc operating when in register with its apertures to give one positive character of indication and obscure the disc which the apertures normally present, and when out of register with the apertures to permit them to disclose their normal disc to give another positive character of indication, substantially as set forth. 8 claims.

6,217. "An improved system of signal communication between the passengers and guard in railway trains." C. Rigby, 347, Tongmoor Road, Bolton, and J. Bentley, 5, Valless's Buildings, Bolton. Dated March 26th. The essential feature is the utilisation of the contact between the buffer heads for continuing the lead of the current from one carriage to the next. Along the under surface of the frame are two line wires provided with switches for disconnecting from the buffers. A battery is located in the guard's van, which is also provided with a bell or other electrical signal. The passengers' compartments are provided with suitable pushes for closing the circuit. Means are described for insulating the buffer arms from one another. 1 claim.

7,458. "Improvements in the electrolysis of metallic salts." C. Kellner, 29, Wasagasse, Vienna IX., Austria. Dated April 11th. The improvements consist in removing the mercury and amalgam formed by the electrolysis from the decomposing cell and conveying same into entirely separated cells, each provided with a separate electrode, and bringing same to a potential independent of the decomposing current. 4 claims.

11,540. "Improved electric primer." The Morris Tube, Ammunition, and Safety Range Company, Ltd., and A. J. H. Wyatt. Dated June 13th. Claim:—In an electrical primer, the combination of two shells, an inner and an outer one, the inner shell, with plug, having a platinum wire attached thereto, and fitted in an insulated manner into an outer shell or tube having a slit or hole for securing the other end of the wire, the end of the outer shell being closed by a wad for retaining the explosive, substantially as described.

11,842. "Improvements in rheostats and other circuit controllers." P. A. Newton. (Communicated from abroad by C. Willms, of Baltimore.) Dated June 18th. Relates to a rheostat of the general class, in which a plate of non-conducting material is used, over which the contact arm moves, and which is provided with a series of contact pins passing through the plate, and closing circuit through resistance material applied to the under side of the plate, certain features of the invention relating particularly to such rheostats of a special construction, in which the resistance material is divided into sections by a series of collecting sectors, consisting preferably of wires extending across the resistance material. 20 claims.

12,229. "Improvements in electric resistances, and in the manufacture thereof." H. J. F. Voigt and J. A. Haeffner. Dated June 24th. Has for its object the manufacture of electric resistances formed of a metallic coating applied to porcelain, glass, talc, earthenware, enamel, or other suitable insulating material. This metallic coating contains metal in a very finely divided condition, like painters' gold or solid gold, or in a thin coherent layer burnt on the insulating substance, as is done with metallic lustres or enamel colours in porcelain manufacture. 3 claims.

12,364. "Improvements in the shuttle mechanism and reeds of looms." P. M. Justice. (A communication from abroad by the Weaver Jacquard and Electric Shuttle Company, of West Virginia, of Norwalk, in the State of Connecticut, all in the United States of America.) Dated June 26th. Relates to a shuttle mechanism for looms, and more particularly to a shuttle mechanism in which the shuttle is moved through the influence of electro-magnets to cause it to reciprocate. 17 claims.

12,420. "Improvements in the manufacture of plates for secondary electrical batteries." C. H. Weibe. Dated June 27th. In a plate constructed according to this invention, the lead oxide is contained within a frame and between perforated plates or sheets. The oxide is hardened by the passage of a current, and still further by its tendency to swell within the enclosed space. 2 claims.